

# ILLUSTRATED ELECTRICAL REVIEW

*A Journal of Scientific and Electrical Progress*

VOL. 28, No. 17.  
WEEKLY.

NEW YORK, WEDNESDAY, APRIL 22, 1896.

\$3 PER ANNUM.  
Single Copies, 10 Cents.

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Entered at Post Office, New York, as Mail Matter of the Second Class.

## VIEWS, NEWS AND INTERVIEWS.

The truly gifted engineer always makes one part of his work fit into another, and no energy is ever wasted, says an exchange. A wealthy engineer who had set up a very fine place in the country, where he had carried out many pet constructive projects, was visited there by an old friend.

The visitor had so much difficulty in pushing open his front gate that he spoke about it to the proprietor.

"You ought to fix that gate," said the guest. "A man who has everything 'just so' should not have a gate that is hard to open."

"Ha!" exclaimed the engineer, "you don't understand my economy. That gate communicates with the waterworks of the house, and every person who comes through it pumps up four gallons of water."

Mr. Brayton Ives, of New York city, chairman of the Executive Committee of the Westinghouse Electric and Manufacturing Company, last week bought for \$1,000 a fine park horse called "X Ray."

Walter K. Freeman, the electrical engineer who has achieved notoriety in many ways, has had another unusual experience. He is on trial in New York city for seduction, and makes his residence in the Tombs. One day last week, while taking walking exercise in one of the jail corridors, Freeman's pocket was picked of his watch. It was found in the possession of one Smith, awaiting trial for burglary. Freeman's experience brings to mind the old story of the convict in Sing Sing who couldn't find his cap. He went to Principal Koeper Connaughton and exclaimed, "Mr. Connaughton, there are thieves in this prison!"

This story of the late Sir Andrew Clark, the English physician, is told by a writer in *Curell's Magazine*. "Two years ago the son of a wealthy nobleman lay in San Francisco suffering from typhoid fever. His friends longed to obtain the advice of the great English physician, but Sir

Andrew could not be brought over in time. Nevertheless, his aid was obtained. The famous doctor went to the London end of the cable; the other end was laid into the sick room in California. Thus a consultation was held under the sea between the English medical authority and his American colleagues, the very best of the sufferer's pulse being registered from time to time, thousands of miles away. The lad recovered."

Russia is to have an electrical branch of her army, under a lieutenant general, two major-generals and five officers of lower grade, who will also have a military electrical school under their charge. Russian military officers have always been adept in the use of electricity.

"We don't want any X-ray jokes," said the editor of an exchange.

## A New Scale Wire Bridge.

The Buffalo Instrument Company, of Buffalo, N. Y., are the manufacturers of the portable scale wire bridge illustrated herewith. A gen-



FIG. 2.—DIAGRAM OF CONNECTIONS, SCALE WIRE BRIDGE.

eral view of the instrument, which is claimed to be an entirely new departure, is given in Fig. 1. The diagram of connections is shown in Fig. 2. The bridge is contained in a mahogany case separate from the batteries. There is but one plug to

half inches; each half inch is divided into 10 degrees, which virtually divides the scale wire into 10,000 separate units or degrees. The chart facilitates reading the scale in making measurements.

The standards of resistance or multipliers of the bridge are 1 ohm, 10 ohms, 1,000 ohms and 10,000 ohms, respectively. The standards are calibrated to embrace one-half of the scale wire, 5,000 units or degrees of the scale (from A to B, Fig. 2), while the other side of the coils is connected to multiplier post D. The standard would be from letter B to A to D. The unknown is across the remaining leg of the diagram (from D to XX).

One side of the receiver or galvanometer is connected to D, the other side being at C, which is a finder or contact to be used in tracing the neutral point over the scale, between XX to B and A. The battery connects between points A and XX.

To find the neutral point, the finder or pointer C is drawn over the manifolds of the "scale wires." It is readily determined on which wire the neutral point lies, as the receiver indicates a sharp, loud sound, except when at the neutral point or close to it, when it becomes weaker and finally is silent at the neutral point. Readings taken with this style of receiver have proved to be fully as sensitive as with the ordinary galvanometer, and in many instances much closer results have been obtained with it. The chart under the scale wire gives the degree of the scale.

This style of instrument is so simple that no adjustment of the instrument is necessary before it is ready for use.

The Central Union Telephone Company will shortly issue \$1,000,000 bonds. The company has a large floating indebtedness, and one-half of the bond issue will be used in payment to the American Bell Telephone Company in discharge of the latter company's account against the Central Union. The other \$800,000 of the bonds will be offered to stockholders at 97½ on the basis of \$100 in bonds for every four shares of stock.



FIG. 1.—A NEW SCALE WIRE BRIDGE.

"Very well," said the humorist; "we will return it to the package and produce the joke about the X-ray joke. Ah, that is played out, too? Then permit me to show you my newest joke about the joke about the X-ray joke, and if that will not do I still have in reserve—"

He got the quarter.

the bridge, which reduces the liability of variable resistance through bad contact of plugs to a minimum.

The variable resistance of the bridge is composed of a continuous scale wire, 500 inches in length, stretched around suitable insulated pins at the end of a table. Under the table is a chart divided into 1,000



## THE DIEHL MANUFACTURING COMPANY.

IMPROVED LINE OF MANUFACTURE BY THIS PROGRESSIVE COMPANY.

Coincident with the incorporation of the Diehl Manufacturing Company, of Elizabethport, N. J., and New York, and the addition of the word "Manufacturing" to the name, a new line of handsome Knight arc

direct-current circuit or work successfully in series on arc and street railway circuits.

The illustration, Fig. 1, is a reproduction from a photograph of a Diehl dynamo directly connected to a Case engine. This installation is on board the steam yacht "Reverie," owned by the president of the Singer Manufacturing Company.

These machines have the armature

Diehl company are preparing, and for the outdoor lamp the company has perfected a design which will be water-proof without the use of a hood. The important feature which will recommend the Knight lamp is that the striking magnet is composed of a few turns of heavy wire placed in the main circuit, and, when the current is on, this magnet is energized and pulls down the core of the short armature, holding the core in this position until it is weakened by the lengthening arc, then the core of the short magnet is released and it goes up to the feeding point. The armature is then practically out-field of the striking magnet and the arc depends entirely on the short magnets for regulation. This avoids the defect usual in the short lamp of not striking a proper arc when current is turned on. The adjustable check carbon-holders take in any size of carbon from one-fourth of an inch to five-eighths of an inch in diameter. The clutch wheel is used, requiring no dashpot nor main magnets. The clutch is applied to the periphery of the wheel; therefore the rod is less liable to stick when dirty than in a lamp with clutch working directly on the rod.

Since the incorporation of the company these officers have been elected: E. H. Bennett, Jr., president; Philip Diehl, vice-president; H. S. Miller, secretary, and J. A. Reid, treasurer. John C. Knight, prominently known in connection with the arc lamp industry, will superintend the lamp making. The New York office will be at 561 Broadway, under the management of C. A. Bramhall.

M. T. Lindenberg will be in charge of the Boston branch, at 128 Essex street.

President Bennett informed a representative of the ELECTRICAL REVIEW that the company were now increasing their facilities by the installation of many thousand dollars worth of new machinery, and it is fair to presume that the Diehl Manufacturing Company will, in the near future, be in the front rank as a manufacturing company.

The illustration, Fig. 4, shows the balance-wheel motor, as applied to the shaft of sewing machines. The motor is self-contained and the field magnets are attached to the shaft of the machine for connection with the current. The armature carrier acts as a balance wheel and is secured to the shaft by the clamp-stock motion. The speed is manipulated by a small brake and rheostat operated by treadle.

## Safety Insulated Wire and Cable Company.

The Safety Insulated Wire and Cable Company, of New York only, last week closed a contract amounting to about \$125,000, to furnish all the underground cables required by the Boston, Mass., Electric Light Company during the current year. This is a renewal of a similar contract made in 1893, which was obtained on the strength of the showing made by Safety cables in 1894.

trictly it contains the carbon by which external power is furnished. It can only be done by or through the means of magnetism, when the energy is applied in the form of power.

The machine that is constructed for the purpose of mechanically wrapping magnetism about or around the conducting wire is called a dynamo.



FIG. 2.—NEW KNIGHT ARC LAMP.

by the electrician, and in doing so it consumes power in the same ratio that the current is allowed to flow through the wire, plus the friction or loss in heat. The battery puts the electricity in a wire circuit in motion by means of chemical action. One of the results of chemical action is electrical pressure, and if a wire is connected to a part of a battery that is under electrical pressure, and be continued even for a great distance, any point in this wire will be found to be under electrical pressure. If this wire is returned to the battery and connected to the part of it that is negative, or has a tendency to an electrical vacuum, then a current will flow as long as the chemical action continues in the battery.

The electric current generated by the dynamo is in all respects like the current generated by a battery; that is, a continuous dynamic current is identical with a battery current. The distant telegraphic instrument then by the proper remodeling becomes a machine that will take power from a passing current, and the part that only vibrated in telegraphy is placed on axles, and revolves when a current is passing through it. The instrument in this shape is called a motor by the electrician.

(To be continued.)

## Desires Light on X Rays—Will Some Manufacturer Kindly Answer?

TO THE EDITOR OF ELECTRICAL REVIEW:

I am desirous of obtaining a little information regarding the X rays and do not know where to apply for it except to you, as I understand that your publication is at the head of everything in the electrical line. What I wish to know is how large a spark an induction coil is obliged to give in order to successfully work a Crookes tube in experimenting with the X rays; also, if the Crookes tubes are furnished in various sizes, and how small an induction coil and Crookes tube can be used that will demonstrate that the X rays exist.

G. E. S.

Towanda, Pa., April 16.

lamps, in a variety of styles, and the improved Diehl dynamo and motors will be placed on the market. At the present time the company's facilities at Elizabethport are taxed to the utmost for the production of Diehl electric fans, which have been long and so favorably known that it is said more than 11,000 of the suspended fans alone are in use.

encircling and revolving around the field magnets, which results in high efficiency, great durability and slow speed, avoiding the method of countershafting and the loss of power it incurs. This slower speed, being due to the large diameter of the armature, is obtained without increase of weight and gives a starting torque proportionately great, at the



FIG. 4.—DIEHL BALANCE WHEEL MOTOR APPLIED TO SEWING MACHINE.

Of these fans the company this year is making new and beautiful designs in venetian, polished brass and nickel and variously ornamented styles, the important feature being, moreover, that a material decrease in the amount of power required has been made. The self-oiling motors in these fans are directly coupled to the fan shafts and operate on any

same time increasing the efficiency by a diminution of friction of the bearings and the brushes. The motors are fitted with self-aligning and self-oiling bearings and approved brush-holders, thereby requiring a minimum of attention.

The illustration, Fig. 2, of the new Knight arc lamp hardly does justice to the elaborate line which the



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# A NEW METHOD OF STUDYING THE LIGHT OF ALTERNATING ARC LAMPS.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, MARCH 25, 1896, BY WILLIAM L. PUTTER.

(Continued from page 197.)

Early in November last the subject was again taken up, with the very efficient aid of Mr. R. E. Lawrence, a post-graduate student in electrical engineering at the Massachusetts Institute of Technology, and rapidly developed with such beautiful results that it was decided to exhibit publicly before the Society of Arts, which was done some little while after, at the regular meeting of January 2, 1896.

We first attempted to take a set of instantaneous photographs of the arc at different periods of an alternation, and by the use of a pneumatic shutter, and a progressive motion of the lens, obtained some very sharply defined pictures. After many trials, this was given up, because of the practical impossibility of timing the exposures with respect to the alternations, and we decided to use a disk with half as many slots as there were pole-pieces on the dynamo, and to drive it by the shaft of the machine itself.

The dynamo available was one giving a three-phase, 500-volt current with a frequency of about 60 cycles. Two wires only were used to give the current required.

A somewhat long, light shaft, carrying at one end the disk, and at the other a positive mechanical clutch, was mounted in line with the armature shaft. As the clutch could only be thrown in when the two shafts were nearly equal in speed, a small motor was placed so as to bring the disk up to speed when the clutch was thrown in and the motor belt removed.

The disk was held in place by a frictional clamp disk on the shaft.

A graduation and reference mark served to measure angular change of disk on shaft, and therefore of slots with reference to the pole-pieces or alternation of the current.

The arc to be tested was put in a box to keep away air from the currents close behind the disk, and a camera with a roll-holder in front of the disk. With this arrangement the arc as seen was perfectly steady at any part of the wave that corresponded to the position of the disk on the shaft, and, as the process of stopping, setting, and starting the disk was very rapid, the roll-holder being in meantime turned, many pictures could be taken in a very few minutes.

Generally, it was not necessary to take more than 12 exposures in order to get a series showing clearly the changes in light intensities during a single phase.

We found that it was about as instructive to watch the appearance of the arc on the ground glass of the camera, and far more beautiful. In this way we examined both the effect produced in the arc by change in the voltage of the circuit, the current being kept constant by alteration of the resistance.

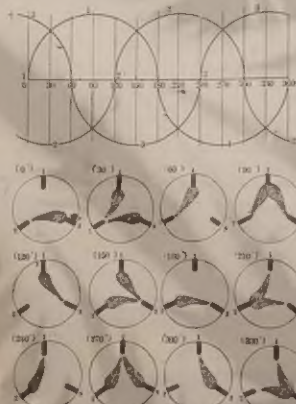
For example, with 500 volts, and a large non-inductive resistance in series with the arc, it was plainly evident that the current wave was approximately sinusoidal, as the time of extinction of the current, as indicated by the blue band of the arc proper, was very short, and the rise and fall of the current gradual and with no irregularities. This is to be expected, as the back electro-motive force of the arc is small compared to the voltage of the generator, and the circuit as a whole is non-inductive.

The opposite condition was realized by using a lower electro-motive force and regulating by reactive coil. The time of no current was longer, and the current appeared to jump to its maximum in an exceedingly small angular time. In this case the arc was not steady, showing clearly to the eye that the succeeding waves of current were not alike either in form or current value, and also that the angle of lag was constantly changing. This fact has always prevented an accurate plotting of wave forms by the instantaneous contact

diode vicinity of the dynamo was not very desirable, owing to air currents and excessive vibration, so we arranged a combination of motors that will produce at any distance from the dynamo all the desired results.

A very nicely balanced brass disk with four radial slots in it was attached to the armature shaft of a Holtzer-Cabot synchronous induction motor of eight poles. The pulley of this motor could be driven by a light belt from a self-starting induction motor of the same make, which is, however, not quite synchronous under load. By trial the two pulleys were wound with rubber tape until their ratio is such that the brass disk will be uniformly driven at a speed a trifle above synchronism, and the arc light through seen through the slots to pass through the alternation at a desirable rate.

By a single movement of a switch the non-synchronous motor is cut out, and the synchronous cut into circuit when the armature drops into step with the dynamo, and the arc is instantly seen as fixed; the belt is thrown off or left on, as desired. These armatures may be on the same



A NEW METHOD OF STUDYING THE LIGHT OF ALTERNATING ARC LAMPS.

method, and although known to exist, was never before actually seen.

A very pretty double arc was arranged by using three carbons and wiring two circuits, each with current regulators, in such a way that the arc was the common junction, and one carbon was of one polarity, while the other two were of opposite polarity. With wire resistances in each side, there was nothing peculiar to be noted other than the effects of the junction of two currents, but when the resistance in one circuit was gradually cut out, and equivalent inductance cut in, there was at once visible evidence of the lag of the current, together with the change of shape of the wave and the unexpectedness before noted. Owing to the long time of no current in the inductive side, there were times when, even with considerable lag, there were actually no visible traces of current between either points. This effect was dependent on adjustment of current strength and inductance as well as voltage. The sequence of currents and polarity in this arc was most beautifully brought out when the disk was disengaged from the shaft, and driven by the little motor at a rate very slightly less than the dynamo.

We found that work in the imma-

shaft, if necessary. The synchronous motor does not stand on its base, but rests on the turned outside of its bearings in pillow blocks, which are attached to a suitable base frame.

Concentric with the shaft and firmly attached to the motor is a brass gear, six inches in diameter, and on it a graduated circle. On a lever pivoted so as to be thrown to or from the motor gear is a small spur gear with a milled head for turning.

Turning this head will evidently cause the motor to slowly rotate about its axle, and as the armature must be in step with the dynamo, and, as the turning of the motor changes relatively to the arc light, it follows that any part of the alternation of current in the arc may be seen on the screen, and as the motor has eight poles, a quarter turn or 90 degrees on the graduated circle corresponds to a complete cycle in the arc.

The picture of the arc can then be photographed, measured, or in any way studied at leisure in any phase relation, as, for example, when the top carbon is positive, or when there is no arc at all and only dull red carbon points visible.

In this way we have seen single arcs of high and low electro-motive

force, long and short double arcs, arcs with much inductance in circuit, Jablotchoff's double arc between a ring and a point carbon, the spinning arc between the ends of a carbon cylinder and a concentric carbon within, with a magnetizing coil around the inner carbon and the like.

One of the most beautiful arcs investigated by us visually and photographically was a rotary arc made by the use of three carbons in the same plane, at angles of 120 degrees apart and wired up as the junction point of an external Y lead on a 500-volt, 60 cycle, three-phase generator. Non-inductive resistance was used in the circuit, and the current used in one leg of the Y was 10 or 15 amperes.

Twelve photographs were taken at equal intervals of 30 degrees in an alternation of the current in one wire. Fig. 1 shows very clearly the relation of the current waves from the different carbon points, and the curved, fan-shaped figure indicates the position and direction of the bluish arc at the corresponding angle. The base of the fan rests on a positive carbon, which has a white-hot crater and all the appearance of the positive carbon of a direct-current arc, while the tip of the fan rests on the white spot at the end of a negative carbon.

It will be seen at 0 degrees, for example, that there is no current on carbon 1 and that 2 is negative and 3 positive, the blue, fan-like arc curving from 3 to 2; 30 degrees later, 2 is still negative and 3 positive, but that an equal arc is now playing from 1 to 2. At 60 degrees 2 is still negative, 1 positive, but there is no current on 3. At 90 degrees the appearance is somewhat like 30 degrees, except that the signs are changed, and the point with the double current is necessarily much whiter, it being now positive. And so on through the changes of the complete wave.

This three-phase arc, when seen while the disk is running non-synchronously, is the most beautiful of any studied, and may be seen according to the different length of arc and the divergence of the disk from exact synchronism, either as a band of blue light, which seems to be progressively traveling over the three sides of a triangular path, or as a rapidly spinning star of blue light, being in fact a rotary arc.

The three phase arc is less noisy than the single-phase, and its light is steadier and has less variation in its total intensity, owing to the fact that the current never stops, and there is always a positive carbon. Three-carbon carbons, placed parallel side by side, with slight magnetizing coils to keep the arc at the ends of the carbons, will give a very satisfactory light in the direction away from the tips, and may be used when it is desirable to throw all the light in one direction.

Four carbons, at 90 degrees apart, each with a suitable resistance in series with it, and connected to quarter-phase tap wires on a Gramme ring or other generator giving quarter-phase currents, will also produce a rotary field arc of great beauty and interest.

Study of these arcs is still going on at the Institute of Technology under my immediate charge, which will, I hope, produce results sufficiently interesting to justify a second paper at some later date.

McClure's Magazine for May will have an article by the eminent surgeon, Dr. W. W. Keen, indicating the uses already possible, as well as those likely to become possible soon, of the Roentgen rays in the study and cure of human deformities, injuries, and diseases. The article will be fully illustrated from photographs taken by the new process.



ROENTGEN RAY DIFFUSION AND  
OPALESCENCE—A NOVEL  
PHENOMENON.

BY FRANK THORNTON.

So far as the writer is aware, the phenomena recently to be described have not hitherto been alluded to by writers on penumbras or Roentgen rays. They are the phenomena of diffusion of Roentgen rays by certain classes of substances in such a way that such substances must be regarded as opalescent or to act like opal glass with respect to ordinary light, or like milky liquids exhibiting diffusion of light from the interior and exterior of the mass.

Some substances are found to behave with Roentgen rays like compacted snow or translucent ice in diffusing light.

Let a large metal screen, such as a brass or iron plate, of one-sixteenth

paper, pine, rubber, cloth of cotton, or wood, the hand of the experimenter, etc., which are tolerably transparent to the rays, are also energetic in diffusing them. That the diffusion is not merely from the surface, and not simply diffuse reflection, is shown by the fact that the rays come also from the back of the object and from portions not exposed directly to the rays. This indicates a true opalescence, like that possessed by opal glass in ordinary light. The inference may readily be drawn from this that the shadow of opaque objects embedded in tissue at considerable depths can never be sharp or black, so to speak, as when the objects are merely surrounded by air. Liquids appear to possess the property as well as solids. It must be borne in mind, also, that the diffusion appears to take place in all directions, within and without the mass of the substance. If the fluorescent screen tube used have thick metal sides, the large metal plate can be dispensed with. In this case it suffices that the screen tube be turned at right angles to the path of the rays or to

erty of diffusibility of Roentgen rays is found in the consideration that, in making images or shadows of bone structures, or opaque objects when a considerable depth of fleshy layer exists between the objects and the sensitive plate, there must of necessity be a blurring or lessening of contrast, owing to diffusion of the rays into the space back of the opaque bodies. Indeed, by using the fluorescent screen tube, it is easy to note that the shadow of a piece of sheet lead is very black when near the screen, although there may be a block of wood, paraffine, or the like, between the lead and the Crookes tube. But the shadow obtained when the wood or paraffine is between the lead and the fluorescent screen is not black, but somewhat milky, thus showing diffusion.

The writer has not tried the experiment, but thinks that a cloud in the air,



FIG. 1.—NOTCHING PRESS WITH CLAMPING ARM, SHOWING RACK AND PINION MECHANISM.



FIG. 2.—NOTCHING PRESS WITHOUT CLAMPING ARM, SHOWING AUTOMATIC STOP.

to one-eighth inch in thickness, be suspended in a vertical place about a foot or more from a Crookes tube kept in action and emitting Roentgen rays toward the plate. On the side of the plate opposite to that next the Crookes tube there will, of course, be a shadow space free from Roentgen rays. While this statement is true in the abstract, it may easily happen that an exploration with a fluorescent screen tube or fluorescent back of the metal plate will show that the rays are not absent, but appear to come around the edge of the plate. This phenomenon has been alluded to by Mr. Edison, and used in support of his supposition that the rays are high-pitch sound.

But on close examination it will be found that the rays back of the metal shield are, mainly, at least, due to diffusion from surrounding objects—the walls or floor of the room, or objects receiving the rays and scattering them.

Further examination will disclose the fact that bodies differ greatly in their diffusive power, and that substances, such as paraffine, wood,

direct it away from the Crookes tube in a line at an angle with the course of the rays. Pieces of various substances may now be placed opposite the end of the screen tube, but in a position to be partially or wholly exposed to the Roentgen rays. The pieces will become virtual sources of rays, and the diffused rays reaching the fluorescent screen will cause it to emit light.

By placing two exactly similar fluorescent screens at opposite ends of a dark tube, and employing a Bunsen photometer screen movable between them, a comparison of diffusing power of pieces of different materials might easily be made by subjecting the materials placed at the ends of the tube, respectively, to equal radiation from the Crookes tube. In fact, the relative effectiveness of two Crookes tubes as producers of the rays could be tested by such a "fluorometer" by passing the same discharge through both, while they were opposite the ends of the "fluorometer." The comparative values of different fluorescent screens could also be tested by slight modifications in the use of the instrument. The practical bearing of this prop-

erty of diffusibility of Roentgen rays is found in the consideration that, in making images or shadows of bone structures, or opaque objects when a considerable depth of fleshy layer exists between the objects and the sensitive plate, there must of necessity be a blurring or lessening of contrast, owing to diffusion of the rays into the space back of the opaque bodies. Indeed, by using the fluorescent screen tube, it is easy to note that the shadow of a piece of sheet lead is very black when near the screen, although there may be a block of wood, paraffine, or the like, between the lead and the Crookes tube. But the shadow obtained when the wood or paraffine is between the lead and the fluorescent screen is not black, but somewhat milky, thus showing diffusion.

Whether true gases have the power of diffusing the rays is not known, but the diffusive power, if it exists at all, is probably very small in such cases.

There was apparently a minimum of diffusive action given by an exhausted incandescent lamp bulb, and what action there was probably came from the glass and may have been reflective.

The metal plates tried gave apparently little diffusive effect, but appeared to reflect feebly at angles equal to the incidence angles. The fluorescence of reflection from surfaces has been worked upon by Mr. Teal, and a number of figures given of the relative reflecting powers of metals, etc., tried.

The diffusive action herein noted is different altogether from reflection, and is obtained at all angles with the surface of the material upon which the rays fall.

## New Press for Notching Armature Disks.

The well known press and die manufacturers, the E. W. Bliss company, 17 Adams street, Brooklyn, N. Y., are calling attention to a press of entirely new design for notching armature core disks, for which they claim superiority in several important respects over other machines for the same purpose. The machine is well illustrated by the accompanying half-tone engravings.

The adjustment for different diameters is made by simply turning the hand-wheel shown. No alteration or readjustment of pawls or indexing parts to suit different diameters is required.

The adjustment for different numbers of notches is effected by means of change-gears instead of the usual pawl and index-plate device. One gear only need be substituted to obtain any desired alteration in the number of notches. This obviates the necessity of using a special indexing plate for each style of disk, and effects a considerable saving, as the change-gears are comparatively inexpensive. If one notch is punched at each stroke, the number of teeth in the gear corresponds to the number of notches in the disk. If two or three notches are punched simultaneously, the number of teeth in the gear is made one-half or one-third, respectively, of the number of notches.

Two standard sizes are being introduced, designated by the makers as No. 15 A and No. 30 A. No. 15 A weighs about 1,500 pounds, and will take disks of from three inches to 30 inches in diameter. It is designed to be run at a high rate of speed—about 60 to 250 strokes per minute, according to the work being done. The larger machine, No. 30 A, weighs about 2,500 pounds. It will take disks of from five inches to 45 inches in diameter, and may be run at about 100 strokes per minute. For very large disks the No. 30 A machine is built with an extra large clamping and indexing frame, so constructed that it will take disks of from 10 inches to 60 inches.

## A Department of Commerce and Manufactures.

A bill which provides for the establishment of a Department of Commerce and Manufactures was introduced in the United States Senate on March 2, by Senator Frye, and was referred to the Committee on Commerce, in whose hands it now rests. This measure is one of great importance to the manufacturing and commercial interests of this country, and there is need for vigorous and immediate support of the bill by those whose interests it directly affects. To secure any action by the committee, or to obtain even a hearing upon the bill, it must be demonstrated to the members of the committee that the business men of the country are in favor of such legislation.

The ELECTRICAL REVIEW believes this movement is worthy of careful consideration, and suggests that its readers send to the National Association of Manufacturers, 1748 North Fourth street, Philadelphia, for free circulars of information on this subject, which is of undoubted importance to the electrical field.

\* Engraving in this article is used to show mechanism of construction, but a play of colors.







dence of that kind is, to say the least, extremely improbable. Besides, the fact may be noted that there is always a difference of potential set up between two metal plates at some distance and in the path of the rays issuing from an exhausted bulb.

Now, since there exists an electric pressure or difference of potential between two metals in close proximity or contact, we must, when considering all the foregoing, come to the fourth conclusion, namely, that the metals emit similar streams, and I therefore anticipate that, if a sensitive film be placed between two plates, say, of magnesium and copper, a true Roentgen shadow picture would be obtained after a very long exposure in the dark. Or, in general, such picture could be secured whenever the plate is placed near a metallic or conducting body, leaving for the present the insulators out of consideration. Sodium, one of the first of the electric contact series, but not yet experimented upon, should give out more of such streams than even magnesium.

Obviously, such streams could not be forever omitted, unless there is a continuous supply of radiation from the medium in some other form, possibly the streams which the bodies themselves emit are merely reflected streams coming from other sources. But since all investigation has strengthened the opinion advanced by Roentgen that for the production of these radiations some impact is required, the former of the two possibilities is the more probable one, and we must assume that the radiations existing in the medium and giving rise to those here considered partake something of the nature of cathodic streams.

But if such streams exist all around us in the ambient medium, the question arises, whence do they come? The only answer is: From the sun. I infer, therefore, that the sun and other sources of radiant energy must, in a less degree, emit radiations or streams of matter similar to those thrown off by an electrode in a highly exhausted inclosure. This seems to be, at this moment, still a point of controversy. According to my present convictions a Roentgen shadow picture should, with very long exposures, be obtained from all sources of radiant energy, provided the radiations are permitted first to impinge upon a metal or other body.

The preceding considerations tend to show that the lumps of matter composing a cathodic stream in the bulb are broken up into incomparably smaller particles by impact against the wall of the latter, and, owing to this, are enabled to pass into the air. All evidence which I have so far obtained points rather to this than to the throwing off of particles of the wall itself under the violent impact of the cathodic stream. According to my convictions, then, the difference between Lenard and Roentgen rays, if there be any, lies solely in this, that the particles composing the latter are incomparably smaller and possess a higher velocity. To these two qualifications I chiefly attribute the non-deflectibility by a magnet which I believe will be disproved in the end. Both kinds of rays, however, affect the sensitive plate and fluorescent screen, only the rays discovered by Roentgen are much more effective. We know now that these rays are produced under certain exceptional conditions in a bulb, the vacuum being extremely high, and that the range of greatest activity is rather small.

I have endeavored to find whether the reflected rays possess certain distinctive features, and I have taken pictures of various objects with this purpose in view, but no marked

difference was noted in any case. I therefore conclude that the matter composing the Roentgen rays does not suffer further degradation by impact against bodies. One of the important tasks for the experimenter remains still to determine rays. In a number of experiments with rays reflected from and transmitted through a conducting or insulating plate, I found that only a small part of the rays could be accounted for. For instance, through a zinc plate, one-sixteenth of an inch thick, under an incident angle of 45 degrees, about two and one-half per cent were reflected and about three per cent transmitted through the plate, hence remain to be accounted for. All the tests which I have been able to make have confirmed Roentgen's statement that these rays are incapable of raising the temperature of a body. To trace this lost energy and account for it is a plausible way will be equivalent to making a new discovery.

Since it is now demonstrated that all bodies reflect more or less, the diffusion through the air is easily accounted for. Observing the tendency to scatter through the air, I have been led to increase the efficiency of reflectors by providing not one, but separated successive layers for reflection, by making the reflector of thin sheets of metal, mica or other substances. The efficiency of mica as a reflector I attribute chiefly to the fact that it is composed of many superimposed layers which reflect individually. These many successive reflections are, in my opinion, also the cause of the scattering through the air.

In my communication to you of April 1, I have for the first time stated that these rays are composed of matter in a "primary" or elementary condition or state. I have chosen this mode of expression in order to avoid the use of the word "atom," which is usually understood in the sense of the Maxwellian interpretation, which would not be in accord with my present convictions in regard to the nature of the radiations.

An observation which might be of some interest is the following: A few years ago I described on one occasion a phenomenon observed in highly exhausted bulbs. It is a brush or stream issuing from a single electrode under certain conditions, which rotates very rapidly in consequence of the action of the earth's magnetism. Now I have recently observed this same phenomenon in several bulbs which were capable of impressing the sensitive film and fluorescent screen very strongly. As the brush is rapidly twirling around I have conjectured that perhaps also the Lenard and Roentgen streams are rotating under the action of the earth's magnetism, and I am endeavoring to obtain an evidence of such motion by studying the action of a bulb in various positions with respect to the magnetic axis of the earth.

In so far as the vibrational character of the rays is concerned, I still hold that the vibration is merely that which is conditioned by the apparatus employed. With the ordinary induction coil we have almost exclusively to deal with a very low vibration impressed by the commutating device or brake. With the disruptive coil we usually have a very strong superimposed vibration in addition to the fundamental one, and it is easy to trace sometimes as much as the fourth octave of the fundamental vibration. But I can not reconcile myself with the idea of vibrations approximating or even exceeding those of light, and think that all these effects could be as well pro-

duced with a steady electrical pressure as from a battery, with the exclusion of all vibration which may occur, even in such instance, as has been pointed out by De La Rive. In my experiments I have tried to ascertain whether a greater difference between the shadows of the bones and flesh could be obtained by employing currents of extremely high frequency, but I have been unable to discover any such effect which would be dependent on the frequency of the currents, although the latter were varied between as wide limits as was possible. But it is a rule that the more intense the action the sharper the shadows obtained, provided that the distance is not too small. It is furthermore of the greatest importance for the clearness of the shadows that the rays should be passed through some tubular reflector, which renders them sensibly parallel.

In order then to bring out as much detail as possible on a sensitive plate, we have to proceed in precisely the same way as if we had to deal with flying bullets hitting against a wall composed of parts of different density with the problem before us of producing as large as possible a difference in the trajectories of the bullets which pass through the various parts of the wall. Manifestly, this difference will be the greater the greater the velocity of the bullets; hence, in order to bring out detail, very strong radiations are required. Proceeding on this theory I have employed exceptionally thick films and developed very slowly, and in this way clearer pictures have been obtained. The importance of slow development has been first pointed out by Professor Wright, of Yale. Of course, if Professor Henry's suggestion of the use of a fluorescent body in contact with the sensitive film is made use of, the process is reduced to an ordinary quick photographic procedure, and the above consideration does not apply.

It is not, therefore, to produce as powerful a radiation as possible, I have continued to devote my attention to this problem and have been quite successful. First of all, there existed limitations in the vacuum tube which did not permit the application of as high a potential as I desired, namely, when a certain high degree of exhaustion was reached a spark would form behind the electrode, which would prevent straining the tube much higher. This inconvenience I have overcome entirely by making the wire leading to the electrode very long and passing it through a narrow channel, so that the heat from the electrode could not cause the formation of such sparks. Another limitation was imposed by streamers which would break out at the end of the tube when the potential was excessive. This latter inconvenience I have overcome either by the use of a cold blast of air along the tube, as I have mentioned before, or else by immersion of the tube in oil. The oil, as it is now well known, is a means of rendering impossible the formation of streamers by the exclusion of all air. The use of the oil in connection with the production of these radiations has been early advocated in this country by Professor Trowbridge. Originally I employed a wooden box made thoroughly tight with wax and filled with oil or other liquid, in which the tube was immersed. Observing certain specific notions, I modified and improved the apparatus, and in my later investigations I have employed an arrangement as shown in the annexed cut. A bulb A, of the kind described before, with a leading-in wire and neck much longer than here shown, was inserted into a large and

(Continued on page 212.)

#### GENERAL ELECTRIC FACTORIES TO BE MOVED.

THE SCHENECTADY, LYNN AND HARRISON PLANTS TO BE CLOSED—THE FINEST ELECTRICAL MANUFACTURING PLANT IN THE WORLD TO BE ERECTED FOR THE COMPANY NEAR ELIZABETH, N. J.—A DEAL OF LARGE PROPORTIONS.

The ELECTRICAL REVIEW is credibly informed from several sources that the General Electric Company will close its large factories at Schenectady, N. Y.; Lynn, Mass., and Harrison, N. J., and will remove its entire manufacturing business to a new and modern plant to be erected for the company near Elizabeth, N. J.

The deal is one of great magnitude and has been hanging fire for over a year and a half. Nearly all the obstacles to its successful accomplishment have been disposed of, and it is expected that the final arrangements may be concluded this week.

The idea had its origin with a syndicate of Elmira, N. Y., and western capitalists, who have made several successes with improvement and industrial enterprises involving heavy land transactions. These gentlemen have formed the New Orange Industrial Association with handsome headquarters at 233 Broadway, New York city. Mr. C. W. Manahan is general manager of the company. Mr. Matthew Arnot, a very wealthy banker of Elmira, is heavily interested in the company, and is understood to be ready to supply any amount of money to carry out the proposed project. He is credited with being worth \$15,000,000.

The New Orange Industrial Association has acquired a tract of land lying between Elizabeth and South Orange, N. J., aggregating five square miles in area. Five prominent railroads cross this tract of land. The scheme includes the building of a standard gauge electric belt line railroad connecting the five steam roads.

In order to make this tract of land valuable, it was necessary for the New Orange Industrial Association to attract manufacturers, and to that end the company is said to have made a most liberal offer to the General Electric Company. This offer is stated to include the following: The land company will build, to the value of \$1,000,000, a manufacturing plant after the General Electric Company's own designs, the plant to be turned over in fee simple to the General Electric Company on its completion. The land company is to give the electric company a cash bonus of \$400,000 and a further allowance of \$175,000 for moving expenses. The old factories belonging to the General Electric Company remain their property, and in time may be sold or leased for a considerable sum.

The combination of the company's manufacturing interests in one place means that 10,000 or more hands will find employment in their factories, and a good-sized town will be required to accommodate the workmen and their families. It is felt that the General Electric Company, by this move, can reduce its manufacturing expenses at least 10 per cent and gain besides the advantages of shipping freight over five of the principal railroads.



## THE NATIONAL ELECTRICAL EXPOSITION.

## SOME OF THE PROPOSED EXHIBITS.

Great interest is being manifested by manufacturers and others in all parts of the country in the National Electrical Exposition, which is scheduled to open on May 1, in the Industrial Building, Lexington avenue and Forty-third street, New York city. Following will be found further particulars of some of the proposed exhibits:

The Mica Insulator Company, New York city, will exhibit their mica and micaite insulating specialties.

The Crocker-Wheeler Electric Company, New York city, will make a comprehensive exhibit in their special field of work.

Spon & Chamberlain, the well known publishers, of New York city, will display electrical and scientific books and publications. Both members of the firm will attend the Exposition.

The new type of armature disk notching press, manufactured by the E. W. Bliss company, Brooklyn, N. Y., will be exhibited in connection with the Crocker-Wheeler dynamo.

The Gombert Manufacturing Company, New York city, will display their steam specialties in a space they have taken, and will show others as a working exhibit in connection with other apparatus.

The Watertown Steam Engine Company, Watertown, N. Y., will exhibit a 10x12-inch, high-speed engine direct connected to an Eddy dynamo. Messrs. Robert E. Cahill and L. Copelton will be in charge of the exhibit.

The Columbia Rubber Works Company, New York, will show a line of hard rubber specialties, such as hard rubber sheet, rod and tubing, telephone receivers and push buttons. They will also exhibit a new fireproof compound.

The Fuel Economizer Company, Matteawan, N. Y., will exhibit sample castings of their economizer, photographs, blue-prints and various plans of boiler houses showing the various applications of their economizers in plants now working.

The Kennedy Valve Manufacturing Company, New York city, will display a line of extra heavy gate valves, especially designed to meet the requirements of modern power plants. They will also show a line of their standard gate and globe valves.

The Bradford Belting Company, Cincinnati, will exhibit their dynamo belting and Monarch insulating paint, of which they are the sole manufacturers. Messrs. E. F. Bradford, O.

M. Hubbard and E. P. Morris will be present during the Exposition.

The Harrisburg Foundry and Machine Works, Harrisburg, Pa., will exhibit a 17x12-inch Ideal engine direct connected to a 40-kilowatt Eddy generator. W. R. Fleming & Company, of New York, will represent the Harrisburg people at the Exposition.

Chas. A. Schieren & Company, New York city, will exhibit their specialties in the electrical line, consisting of large three-ply and double main driving belts, and smaller sizes for use on street railway generators and electric light dynamos and all high-speed work.

The Riker Electric Motor Company, Brooklyn, N. Y., will exhibit several of their new fan motors, standard Riker machines and a direct-connected plant, consisting of a Riker dynamo and a Case engine. The latter is similar to those the company installs for yacht-lighting.

The Newtney Electric Company, Cincinnati, will show their ironclad motors and dynamos and a number of entirely new electric light specialties of their own manufacture. President L. R. Keck, General Manager John S. Newtney, and Mr. W. M. Venable will be present.

The Phoenix Iron Works Company, Meadville, Pa., will exhibit a Dick & Church tandem compound, non-condensing, automatic cut-off engine of 125 horse-power, direct connected to a 75-kilowatt Walker generator. Mr. C. A. White, of the company's New York office, will have general charge of the exhibit.

The Straight Line Engine Company, Syracuse, N. Y., will show a 13x15-inch, 125-horse-power engine direct connected to a 75-kilowatt General Electric dynamo and a 10x14-inch, 80-horse-power engine direct connected to a Crocker-Wheeler dynamo. The latter engine, it is understood, will be driven by compressed air.

The Ashcroft Manufacturing Company, New York city, will have a prominent exhibit of consolidated safety valves, Metropolitan injectors, Moseley recorders, and Edison pressure recording gauge. The manufacturing privilege for the latter, this company have recently secured. This exhibit will probably be one of the most interesting in the line of steam specialties.

The Electrozone Company, New York city, intend to exhibit a working model manufacturing electrozone, a working model showing the Woolf process of bleaching wood pulp by electricity, and a working model showing the Woolf process of manufacturing caustic soda by electrolysis. The potency of the electrical disinfectant will be shown by killing infusoria and the lower forms of animal germ life.

Stanley & Patterson, of New York, will display a line of general electric light and electric bell supplies. As eastern agents they will represent the New York & Ohio company, manufacturers of Peckard lamps; Brant & Thompson, manufacturers of porcelain goods; Indiana Rubber & Insulated Wire Company, manufacturers of Paraffin wire, and the E. G. Bernard company, manufacturers of dynamos and motors. Messrs. Stanley, Patterson, Mead and Mays will be in attendance.

The E. T. Burrows Company, Portland, Me., will exhibit models showing several styles of their automatic curtains for electric railway cars. They will also show a new waterproof curtain material called Oakette. Another part of their exhibit will be a cable device for holding curtains on an open car in place and a pinch handle device for an inside shade. While this exhibit will be small, the company will endeavor to make it interesting, as the curtain equipment of a car is by no means its least important feature.

The Standard Underground Cable Company, Pittsburgh, will exhibit a few reels of cable showing their standard fiber insulation and a specialty will be made of samples representing some of their most important recent contracts. There will also be a show rack for wires and cables and especially for small samples of lead-covered cable for distribution. Manager G. L. Wiley, of New York, and an assistant will attend the exhibition regularly, and Vice-president Marsh, of Pittsburgh, and Manager J. R. Wiley, of Chicago, will be present several days. The Standard company will distribute a novel electrical souvenir.

Hugo Reisinger, New York city, will make an extensive carbon exhibit, consisting of "Electra" high-grade Nuernberg carbons for arc lighting, for direct-current arc lamps on incandescent circuits, and for alternating current arc lamps; all descriptions of the finest grade of microphone carbons used in the manufacture of telephones; all descriptions of the very finest grades of battery carbons, and carbons used for search-lighting, for the manufacture of aluminum and for smelting all kinds of ores. Messrs. J. F. Outwater and Fred Nolker will represent Mr. Reisinger at the Exposition.

The exhibit of the Card Electric Motor and Dynamo Company, Cincinnati, will consist, in part, of the following apparatus: One 25-kilowatt generator directly connected to a Payne high-speed, automatic engine; a motor operating a Hoe press, the armature of the motor being directly connected to the shaft of the press in the place of the pulleys; a motor directly connected to a 37-inch Niles boring mill; a motor directly connected to a Niles six-foot radial drill and a three horse-power motor belted to a horizontal boring mill. They will also supplement their

exhibit with some other special features which have as yet not been definitely decided upon.

In view of the importance of the occasion, the exhibit of the United States Patent Office at the National Electrical Exposition will be made one of unusual size and interest. As now arranged by the department, under the instructions of Mr. S. T. Fisher, the acting commissioner, it will include no fewer than 351 separate models of electrical devices, apparatus, machinery and appliances, many of them embodying the fundamental and elementary ideas upon which the modern electrical arts have been founded. These models will occupy over 300 linear feet, and will be carefully grouped and classified, so that students of whatever character can follow the general lines of growth or evolution.

The Partrick & Carter Company, Philadelphia, will exhibit a general line of house goods, consisting of hotel and house annunciators, burglar alarms, hotel fire-alarm systems and return calls, and also a full assortment of bells, pushers and numerous other household electrical appliances. They will have in operation a complete line of their own goods, and it is their intention, if possible, to have on hand, during the entire time of the exhibition, thoroughly competent attendants. They will call in from the road two or three of their most important salesmen, among them Mr. Thos. L. Townsend, who is known to the general trade from Maine to California, to be on hand to visit the firm's many friends who visit the Exposition. It is also the intention of the members of the firm to be at the Exposition as much as they can conveniently.

The General Electric Company will occupy 400 feet of space fitted up as a headquarters and general reception room. They will show, as a still exhibit, a number of their latest long burning arc lamps, a selection of inclined coil instruments and a few meters. They expect to have a representative collection of bromide prints illustrating the company's latest types of apparatus and photographs of representative installations. The Convention Committee of the company, consisting of S. D. Greene, chairman; Chas. T. Hughes, vice-chairman; Fred M. Kimball, secretary; A. D. Page, lamp works; T. Beran, of the New York Supply Department, and E. N. Beyer, of the Chicago Supply Department, will probably be present during the entire convention. Messrs. H. J. Boddy, representing the Philadelphia office; A. F. Giles, representing the Atlanta office; W. J. Forris, representing the Chicago office, and Messrs. Chas. B. Davis, A. R. Bush, C. S. Haley and A. W. Ives, representing the Boston office, together with representatives from the railway, power, and mining departments and the New York office, will attend.

Keuffel & Esser company, New



York city, will show a handsome collection of drawing instruments and supplies and surveying instruments, such as are used in electric railway construction.

The C. W. Hunt company, New York city, will show Hunt's noiseless and frictionless conveyor adapted to the service of boilers in power stations. Mr. Harry P. Barr will be in charge of the exhibit.

Huebel & Manger, Brooklyn, N. Y., will make a handsome display of their electrical and brass goods. Mr. W. W. McChesney, Jr., will be in charge, and the members of the firm will be present to welcome their friends.

The Birdsell Electric Manufacturing Company, of New York city, will show a novel line of combination electrical specialties, which will undoubtedly attract attention. A few of them were recently described in the ELECTRICAL REVIEW.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., will exhibit a two-phase S. K. C. generator, a two-phase alternating current motor, transformers and switchboard apparatus. Mr. T. E. Theberath, the company's New York representative, will have charge of the exhibit.

The Peru Electric Manufacturing Company, Peru, Ind., will make a complete display of all the different pieces of porcelain which they manufacture, together with an exhibition of their Laclode and Hercules batteries. Messrs. Bouslog, Schutt and Stevens will be in charge of the exhibit.

The Crane company, New York city, will show samples of their extra heavy I. B. gate valves for 200 pounds working pressure, extra heavy I. B. globe and angle valves for 200 pounds working pressure, standard and indicator valves, iron body blow-off valves, extra heavy flanged fittings for 200 pounds working pressure, and samples of many of their smaller specialties, such as brass valves, Pope safety valves, water relief valves and the like.

The Interior Conduit and Insulation Company, New York city, have secured a large space and will show in operation a printing press run by a direct-connected Lundell motor, exhaust fan outfits, 60 inches, 36 inches and 12 inches; direct-connected generating set, Lundell power motors, Lundell generators, Lundell desk-fan motors and ceiling-fan motors, Lundell dental outfits, Lundell emery wheel grinder, Lundell buffing machine and Lundell organ-blowing outfit. The latter outfit will be attached to a Mason & Hamlin organ, which will be played each evening. The company will also exhibit their complete system of plain, brass-armored and iron-armored insulating conduits as well as their complete underground conduit system. An illuminated sign 30 feet in length

will be shown. The following named gentlemen will be in attendance and explain the various novelties: Messrs. D. C. Durland, Geo. H. Kimble and E. B. Kittle.

In connection with the opening ceremonies of the National Electrical Exposition, when it is proposed to start the machinery by a circuit that has first looped in the whole continent, the Postal Telegraph Cable Company, through its vice-president, Mr. W. H. Baker, has very courteously offered its fine service between New York and San Francisco for the purpose. The Postal company has been equipping its lines with heavy copper circuits and believes that it can illustrate rapidly of working by the instantaneity of its transmission on May 4, when the mere pressure of the golden key will flash the signal to the golden gate and back to the Exposition building in the twinkling of an eye. Arrangements are now being made with the Postal officials for the execution of this interesting plan, with the co-operation of the long string of offices scattered over the 6,000 miles of wire.

J. C. Vetter & Company, New York city, will make an exhibit to

exceedingly simple form of construction, and one for which is claimed very superior results. The governor consists of but two pieces and one bearing, thus reducing friction to the minimum and the chances of disarrangement. It is stated by manufacturers that this governor will move through the entire range, viz., from 0 to 54 cut-off in less than one-fifth of a second, and it overcomes what is commonly known as "dancing" in the centrifugal governor. The Payne people will have another feature which will attract a good deal of attention. It is an automatic return oil circulation system, by means of which the oil is delivered in a stream to the main bearings by gravity, and drained to a central point at the bottom of the base. By means of a small oil pump working on the rocker arm of the valve rod, it is pumped to the receptacle on top of the frame, where it is filtered and re-used. Carefully designed oil guards prevent any oil being thrown from the engine; and at the same time it is not the inclosed type. The Payne company will be represented at the Exposition by S. H. Payne, N. B. Payne and F. N. Jewett, of the New York office.



SOCKETLESS DECORATIVE INCANDESCENT LAMPS.

demonstrate the application of the constant incandescent current in electro-therapeutics, by means of various instruments designed for the purpose. This apparatus consists of the following: Vetter current tap, by means of which the current from any lamp socket can be carried to a drop-light or fan motor without interfering with the lamp; current adapter, by means of which the lamp in the socket can be placed in series, and the current thus reduced and limited by the capacity of the lamp; carbon current controller; volt controller; standard milliammeter; caution rheostat and various combinations of the above apparatus in the way of table bases, switchboards and cabinets. A feature of this exhibit will be a cabinet lately designed, which, in connection with the constant incandescent current, furnishes for electro-therapeutical purposes the galvanic current, faradic current, sinusoidal current, caution current, motor current and current for small diagnostic lamps. All these currents can be modified and manipulated to the finest degree. Mr. A. F. Vetter will attend the Exposition.

The Payne Engine Company, of 41 Dey street, New York city, and Elmira, N. Y., will have one of their new type direct-connected engines of 50-horse-power capacity connected to a 25-kilowatt card generator. This machine will undoubtedly be of unusual interest, from the fact that it will have an improved inertia governor of an

adequately exhibiting the working of its complicated and extensive plant in any reasonable space, the Metropolitan Telephone and Telegraph Company will make an exhibit illustrative of its New York city service as viewed from the user's standpoint. The manner in which this will be carried out involves, nevertheless, a more elaborate installation than might appear from the exhibit proper, as the company will place telephone stations at a number of exhibitors' spaces, as well as at points where service is desired by the Exposition company. These stations will be connected to a switchboard in the company's space, thus forming a small exchange within the exhibition itself. This service will be furnished without charge to the exhibitors and to the Exposition company by the Metropolitan Telephone Company, which will furnish the entire installation and maintain the service at its own expense. Besides the switchboard, the company will install in its own space four silence booths of different types, each equipped with telephone instruments of the various styles used by New York city subscribers. These will all be working stations connected with the Thirty-eighth street exchange and will be available to visitors to the exhibition in the same way as an ordinary public pay station. This remarkably useful form of exhibit will no doubt be highly appreciated by exhibitors who can not fail to

realize the convenience of being placed in easy communication with each other and with their home offices. The exhibit proper will afford the public ample illustration of the excellent service furnished by the Metropolitan company and of the high grade of equipment provided for public and subscribers' stations. Those visitors who display particular interest in the operation of a city telephone system will be invited to visit one of the company's large exchanges, where they can examine in detail the nature and operation of the plant, which are practically impossible of reproduction in an ordinary exhibition.

#### PERSONAL.

Mr. C. M. Morse, of the Buffalo Engineering Company, Buffalo, N. Y., visited New York city last week.

Mr. Albert L. Johnson, of Cleveland, has been elected president of the Nassau Electric Railway Company, of Brooklyn, N. Y.

Among the out-of-town electrical men who visited New York city last week were Messrs. Estep, of Pittsburgh; C. J. Mayer, of Philadelphia, and Louis Myer, of Chicago.

Mr. P. H. W. Smith has been appointed assistant general manager of the Standard Underground Cable Company. Mr. Smith's training in electrical matters was received at Lehigh University, of which he is a graduate. He has been actively connected with the Standard Underground Cable Company for a number of years in the construction and sales departments, and the advancement is well merited and will be appreciated by his many friends. Mr. F. S. Viole has been made manager of the conduit and the general construction departments. Mr. Viole is a graduate of Massachusetts Institute of Technology in Electrical Engineering, and his ability in matters pertaining to insulated wires and cables makes him a valuable man for the company.

#### A Socketless Decorative Lamp.

The Empire Lamp Works, 154 and 156 West Twenty-seventh street, New York city, have just placed upon the market a series decorative incandescent lamp with which no socket is required. The accompanying illustration shows the lamps half size. They are made for three candle-power to run four in series on 50 to 60 volts, and eight in series on 110 to 120 volts. The lamps are especially suitable for decorative and display effects, and when hung in chains and festoons present a very beautiful appearance.

"I tell you what," said a fat, red-faced man as he stood in Park Row one evening last week; "I was just going to take that horse-car there, but I didn't, not on your tin-type, when I saw the sign in the window."

"What was it?" asked a friend. "What was it?" repeated the fat man, scornfully. "What was it? It was 'This car is heated.' These horse-car managers must be gibbering idiots."



## THE HISTORY OF ELECTRIC HEATING APPLIED TO METALLURGY.

READ BEFORE THE WASHINGTON SECTION OF THE AMERICAN CHEMICAL SOCIETY BY FREDERIC P. DEWEY.

(Continued from page 193.)

In 1887-88 a series of patents was granted to M. P. L. T. Heroult, in which alumina was melted by the passage of the current and then electrolyzed with molten copper, or iron, as the cathode with which the separated aluminum alloyed.

The furnace (Fig. 8) was a suitable containing vessel of carbon to which the negative wire was attached. The positive electrode was of carbon. In running the furnace, copper or iron was first put in and melted by the current, then alumina was added, which was also melted and then electrolyzed by the current. More alumina and copper, or iron, were added from time to time, and the resulting alloy was tapped out periodically.

This was a very promising high heat alloying process, but it, as well as the Cowles process, was superseded in the aluminum field by the Hall process of producing the pure metal, of which it is only necessary to say here that in this process the charge is both melted and electrolyzed by the current, but the fact is to be emphasized that only a comparatively low temperature is required.

From 1892 to March 15, 1895, there has been much published regarding the work of M. Henri Moissan, who has done so much fine work in the field of high temperatures, and has accomplished such wonderful results.

He employed various styles of furnaces and different amounts of current. His early furnace (Fig. 9) consisted of a simple block of quicklime suitably bound and provided with electrodes and a cover. In this, some very interesting results were obtained. Another furnace (Fig. 10) was especially designed for determining the temperature by the specific heat method. A piece of carbon was put on the end of one electrode, the current passed and the carbon pushed off from the electrode; at the same time a slide was withdrawn from the bottom of the furnace and the hot carbon allowed to fall in the calorimeter below. A number of temperature determinations were made in connection with M. Vielle. Another furnace (Fig. 11) was provided with tubes for the introduction of gases. In this, pure and colorless carbide of silicon was formed from carbon and silicon vapors. This furnace also had various layers, beginning with lime on the outside, and followed by carbon and then magnesia on the inside, or vice versa. Another furnace (Fig. 12) had transparent ends of glass, or mica, so that the operations could be watched. It also had magnets to direct and control the arc.

In this, Moissan designed to investigate and study the simple heating effect of the current separated as much as possible from any electrolytic effect. He speaks of and treats the arc as one would speak of an ordinary flame.

Moissan began with a very moderate current of 35 to 40 amperes at 55 volts, and passed through various stages up to 1,300-1,600 amperes at 110 volts.

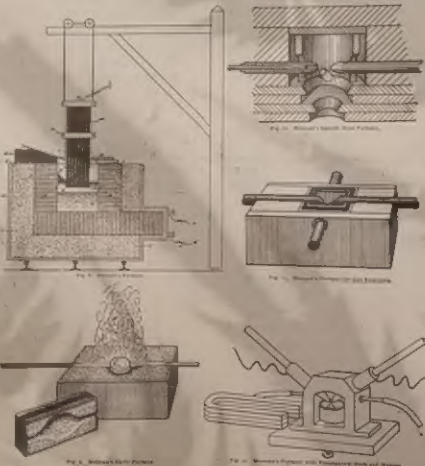
A few of the results obtained by Moissan may be mentioned. Magnesia was the only irreducible oxide found; it was melted and volatilized. Lime, strontia and magnesia began to volatilize before melting. Lime was easily melted and the metal calcium reduced, but it immediately combined with the carbon vapor, forming calcium carbide (CaC). Alumina and platinum were volatilized. Artificial diamonds were produced. Various temperatures from 2,600 degrees to about 3,500 degrees centigrade were measured. Carbon begins to volatilize at about 3,500 degrees centigrade. Various quantities of the rarer metals were reduced: 200 to 300 grammes of uranium; 100 grammes of vanadium; 10 kilos of chromium, as well as manganese.

As in practical flame work, the amount of fuel burned determines the temperature of the furnace, so in this case the amount of current passed determines the temperature and the furnace must be employed to stand the current to be employed. While Moissan's small furnace will stand the temperature developed by small currents, yet with 1,300 amperes at 110 volts the lime and mag-

nesium, in which a mixture of silica, carbon and salt was heated by the passage of the current, and silicon carbide produced, which has found considerable application as an abrasive.

In the present early stage and activity of the calcium carbide and barium carbide questions, it might not be wise to go into the details of the work and the claims of the various workers (Borscher, Maquenne, Moissan, Trovay, Willson—I arrange these names simply alphabetically), but I mention these various carbide processes to show the present condition of our subject, and to draw especial attention to a notable fact.

In reviewing our subject we find that in the early days the current was suggested, tried and used for various metallurgical operations, in which both the heating and decomposing actions of the current were utilized. Then in the principal, practical part of the field, that of the production of sodium and aluminum, the generation of intense temperatures became paramount. This activity culminated in the high heat processes of Cowles and Heroult, and they were very soon superseded by the low temperature



ELECTRIC FURNACES MENTIONED IN "THE HISTORY OF ELECTRIC HEATING APPLIED TO METALLURGY."

nesia melt down, volatilize rapidly, and in a few moments the furnace is spoiled at a temperature of about 3,500 degrees centigrade.

For materials of construction it was found that lime was the best non-conductor for heat, but its fusibility and the ease of forming the carbide prevent its use for the inside of the furnace at very high temperatures. Compared with lime, carbon is a good conductor of heat. Magnesia is also a better heat conductor than lime. It does not form carbide of magnesium, and therefore can be heated very hot in direct contact with carbon, while lime can not. It, however, is volatile, and can be melted at very high temperature. Practically, therefore, the outside of the furnace is quicklime, while the interior is variously lined with carbon or magnesia, or both, and when carbon is in direct contact with the lime it must not get too hot at the point of contact.

In 1893 a United States patent, No. 492,767, was issued to E. G.

process of Hall for the production of aluminum, which carried with it the greater part of the demand for the production of sodium.

At the present day, therefore, there is no practical production of metals by high electric heats, with the possible exception of the production of chromium. On the other hand, high electric heats are being employed to go a step beyond the reduction of metals, and to form new compounds, as in the carbide processes mentioned. In these the metals are first reduced and are then immediately recombined with carbon, and thus in the field of high heat our subject becomes the application of high electric heat to chemistry.

## Medico-Legal Society.

At the monthly dinner of the Medico-Legal Society, held at the Hotel Marlborough, New York city, on April 15, Dr. J. Mount Bleyer read a paper on "The Roentgen Rays in Medico-Legal Surgery."

## TELEPHONE NEWS AND COMMENT.

There are said to be 150 opposition telephone companies in Ohio, Indiana, Illinois, Michigan and Wisconsin.

The directors of the Central Union Telephone Company have reduced the quarterly dividend from one and one-quarter per cent to one per cent.

The annual meeting of the New England Telephone and Telegraph Company will be held in New York May 4. Books closed April 2 and will open May 5.

The Central New York Telephone and Telegraph Company has issued its official list of subscribers No. 11. The list covers Syracuse, Utica and surrounding towns and is contentiously arranged.

A committee of the directors of the Erie Telegraph and Telephone Company have just returned from a thorough inspection of the telephone property in Minnesota, Arkansas and Texas, which they report in excellent condition.

The Elkhart, Ind., Telephone Company prints the following on its directory of subscribers: "Our rates are five cents per day for residences and seven cents for business houses. We have no war rates. Our office and exchange is over 229 South Main street. Come and see us."

The Erie Telegraph and Telephone Company has at present 28,000 miles of exchange lines, 19,000 subscribers and is increasing at the rate of 2,400 per annum. Already \$100,000 has been invested in real estate, and it is the intention of the company to erect its own buildings in cities where there are 700 subscribers. These buildings cost about \$15,000 each.

The Southern Massachusetts Telephone Company has commenced the work of putting its wires underground in Brockton, Mass., and expects to finish the job about July 1. The city wires will go underground with the telephone company's wires, but the electric light company will be compelled to find another way of providing for their wires, as it has been notified by the telephone company that it is intended to remove the poles in July.

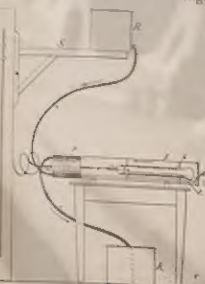
A circular has been issued by the American Bell Telephone Company respecting the issue of 21,000 new shares of stock. Each stockholder of record March 31, 1896, is entitled to take and pay for shares of the new stock in the proportion of one share for every 10 shares then held. This right to subscribe will expire at 10 o'clock Saturday, May 18, 1896. Payment for full shares equal to one-half of the shares so subscribed for at the rate of \$200 for each share must be made to the treasurer Wednesday, July 1, 1896, and for the remainder on Thursday, October 1, 1896.



## TESLA'S LATEST ROENTGEN RAY INVESTIGATIONS.

(Continued from page 208.)

thick glass tube *c*. The tube was closed in front by a diaphragm *d* of paraffin, and by a rubber plug *p* in the back. The plug was provided with two holes, into the lower one of which a glass tube *f*, reaching to very nearly the end of the bulb, was inserted. Oil of some kind was made to flow through rubber tubes *r* from a large reservoir *R*, placed on an adjustable support *S*, to the lower reservoir *R*, the path of the oil being clearly observable from the drawing.



By adjusting the difference of the level between the two reservoirs it was easy to maintain a permanent condition of working. The outer glass tube *f* served in part as a reflector, while at the same time it permitted the observation of the bulb *b* during the action. The plug *p*, in which the conductor *c* was tightly sealed, was so arranged that it could be shifted in and out of the tube *f*, so as to vary the thickness of the oil traversed by the rays.

I have obtained some results with this apparatus which clearly show the advantage of such disposition. For instance, at a distance of 45 feet from the end of the bulb my assistants and myself could observe clearly the fingers of the hand through a screen of tungstate of calcium, the rays traversing about two and one-half inches of oil and the diaphragm *d*. It is practicable with such apparatus to make photographs of small objects at a distance of 40 feet, with only a few minutes exposure, by the help of Professor Henry's method. But, even without the use of a fluorescent powder, short exposures are practicable, so that I think the use of the above method is not essential for quick procedure. I rather believe that in the practical development of this principle, if it shall be necessary, Professor Salvioni's suggestion of a fluorescent emulsion, combined with a film, will have to be adopted. This is bound to give better results than an independent fluorescent screen, and will very much simplify the process. I may say, however, that, since my last communication, considerable improvement has been made in the screens. The manufacturers of Edison's tungstate of calcium are now furnishing screens which give fairly clean pictures. The powder is fine and it is more uniformly distributed. I consider, also, that the employment of a softer and thicker paper than before is of advantage. It is just to remark that the tungstate of calcium has also proved to be an excellent fluorescent in the bulb. I tested its qualities for such use immediately and find it so far unexcelled. Whether it will be so for a long time remains to be seen. News reaches us that several fluorescent bodies, better than the cyanides, have been discovered abroad.

Another improvement with a view of increasing the sharpness of the

shadows has been proposed to me by Mr. E. R. Hewitt. He assumed that the absence of sharpness of the outlines in the shadows on the screen was due to the spread of the fluorescence from crystal to crystal. He proposed to avoid this by using a thin aluminum plate with many parallel grooves. Acting on this suggestion, I made some experiments with wire gauze, and, furthermore, with screens made of a mixture of a fluorescent with a non-fluorescent powder. I found that the general brightness of the screen was diminished, but that with a strong radiation the shadows appeared sharper. This idea might be found capable of useful application.

By the use of the above apparatus I have been enabled to examine much better than before the body by means of the fluorescent screen. Presently quite clearly, even in the lower part of the body, I have also clearly noted the outlines of the hip bones. Looking in the region of the heart I have been able to locate it unmistakably. The background appeared much brighter, and this difference in the intensity of the shadow and surrounding has surprised me. The ribs I could now see on a number of occasions quite distinctly, as well as the shoulder bones. Of course, there is no difficulty whatever in observing the bones of all limbs. I noted certain peculiar effects which I attribute to the oil. For instance, the rays passed through plates of metal over one-eighth of an inch thick, and in one instance I could see quite clearly the bones of my hand through sheets of copper, iron and brass of a thickness of nearly one-quarter of an inch. Through glass the rays seemed to pass with such freedom that, looking through the screen in a direction at right angles to the axis of the tube, the action was most intense, although the rays had to pass through a great thickness of glass and oil. A glass slab nearly one-half of an inch thick, held in front of the screen, hardly dimmed the fluorescence. When holding the screen in front of the tube at a distance of about three feet, the head of an assistant, thrust between the screen and the tube, cast but a feeble shadow. It appeared some times as if the bones and the flesh were equally transparent to the radiation passing through the oil. When very close to the bulb, the screen was illuminated through the body of an assistant so strongly that, when a hand was moved in front, I could clearly note the motion of the hand through the body. In one instance I could even distinguish the bones of the arm.

Having observed the extraordinary transparency of the bones in some instances, I at first surmised that the rays might be vibrations of high pitch, and that the oil had in some way absorbed a part of them. This view, however, became untenable when I found that at a certain distance from the bulb I obtained a sharp shadow of the bones. This latter observation led me to apply usefully the screen in taking impressions on the plate. Namely, in such case it is of advantage to first determine by means of the screen the proper distance at which the object is to be placed before taking the impression. It will be found that often the image is much clearer at a greater distance. In order to avoid any error when observing with the screen, I have surrounded the box with thick metal plates, so as to prevent the radiations, in consequence of the fluorescence, reaching the screen from the sides. I believe that such an arrangement is absolutely necessary if one wishes to make correct observations.

During my study of the behavior of oils and other liquid insulators, which I am still continuing, it has occurred to me to investigate the important effect discovered by Prof. J. J. Thomson. He announced some time ago that all bodies traversed by Roentgen radiations become conductors of electricity. I applied a sensitive resonance test to the investigation of this phenomenon in a manner pointed out in my earlier writings on high frequency currents. A secondary, preferably not in very close inductive relation to the primary circuit, was connected to the latter and in the ground, and the vibration through the primary was so adjusted that true resonance took place. As the secondary had a considerable number of turns, very small bodies attached to the free terminal produced considerable variations of potential on the latter. Placing a tube in a box of wood filled with oil and attaching it to the terminal, I adjusted the vibration through the primary so that resonance took place without the bulb radiating Roentgen rays to an appreciable extent. I then changed the conditions so that the bulb became very active in the production of the rays. The oil should have now, according to Prof. J. J. Thomson's statement, become a conductor and a very marked change in the vibration should have occurred. This was found not to be the case, so that we must see in the phenomenon discovered by J. J. Thomson only a further evidence that we have to deal here with streams of matter which, traversing the bodies, carry away electrical charges. But the bodies do not become conductors in the common acceptance of the term. The method I have followed is so delicate that a mistake is almost an impossibility.

NIKOLA TESLA.

New York, April 20.

## Law Battery Company Burned Out.

The new plant of the Law Battery Company, at Cranford, N. J., was burned out on April 18. The heavy machinery was not damaged and the other losses are fully covered by insurance. The company is prepared to fill orders as usual.

## New Telephone and Telegraph Companies.

CHEROKEE, IOWA.—The Cherokee Telephone Company has been incorporated by James E. Weart, R. L. Robie, A. B. Ross, W. H. Lysaght and W. A. Sanford. Capital stock, \$25,000.

CHLESEA, MICH.—The Chelsea Telephone Company has been incorporated by Lynn L. Gorton, Henry Gorton, A. W. Wilkinson and others. Capital stock, \$10,000.

WARREN, VT.—A telephone line is to be put in between this place and Roxbury, and will eventually be connected with the Northfield exchange.

INDIANAPOLIS, IND.—The Crown Point Telephone Company has been incorporated. Capital stock, \$10,000. George W. Fisher is interested.

MADISON, WIS.—It is reported here that the Postal Telegraph Company intends extending its line from Freeport to this place, and that an office will be opened here by June 1. Gay E. Paine, manager of the Postal company in Chicago, is in the city looking for a suitable office.

## NATIONAL ELECTRIC LIGHT ASSOCIATION.

## RAILROAD ARRANGEMENTS.

To the Editor of Electrical Review:

Arrangements have been made whereby delegates on the line of the Chicago & Alton road can use that road to Chicago and connect with the electrical special at that point for a fare and one-third, on the certificate plan. This will enable the St. Louis delegates to leave that city at 11.30 p. m., reaching Chicago at 8.30 a. m. the following day, which will enable them to remain in the latter city until the time the electrical special leaves, namely, 5 p. m. Saturday, May 2.

Very truly yours,

C. O. BAKER, JR.,  
Master of Transportation.

New York, April 17.

## HOTEL ARRANGEMENTS.

To the Editor of Electrical Review:

I am pleased to inform you that the Murray Hill Hotel, Forty-first street and Park avenue, has been selected as the hotel headquarters for delegates to our nineteenth convention, May 5, 6 and 7.

It is stipulated, however, by the hotel management that none of the guests make use of any part of the hotel for exhibition purposes or display any signs or placards in the halls or corridors.

The Exposition to be held under the auspices of this association will open May 4 in the Industrial Building, two blocks from the hotel headquarters. Respectfully,

Geo. F. POHLE,  
Secretary.

New York, April 17.

## Carbide of Calcium—Acetylene Gas.

The *Progressive Age* of April 15 presents the report of a commission which that enterprising journal sent to Spray, N. C., to investigate acetylene. The gentlemen were Messrs. Houston and Kennelly, of Philadelphia, and Dr. Leonard P. Kinnicutt, chemist. After a very exhaustive test the decision of the commissioners is summed up in the following table and paragraph:

Materials per day and per ton of gross carbide	\$24.38
Labor per day and per ton of gross carbide	11.00
Water power, 1,500 h.p.	8.00
Petty stores, waste, etc., \$100 per annum	.41
Taxes at \$100 per annum	.41
Interest on investment at 5% per cent.	.374
\$11.53	1.829
Depreciation and repairs, five per cent on electric plant and turbines	1.829
Site per cent, on acreage, including rolls and crusher	.468
Twenty per cent on European	.021
	\$28.791

Our estimate, therefore, of the cost of producing calcium carbide at Spray—by working the furnaces 365 days a year and 24 hours a day, yielding on the average one ton of 2,000 pounds gross carbide a day—is \$28.791 per ton. Of this amount \$14.39 is for material. The freight charges on lime and coke are heavy at Spray and add materially to the cost.

## Walter K. Freeman Convicted.

Walter K. Freeman, an electrical engineer, formerly of New York city, was convicted on Friday last in the Court of General Sessions in this city of criminal assault in the second degree. The extreme penalty for this crime is 10 years imprisonment.











# THE "A. B." ARC LAMP

## THIS IS THE "Evolved" Arc Lamp

the lamp station men have been looking for all these years.

They have given the old style lamp a 20-years' tussle and are getting tired.

Too many trimmers and patrolmen spoil the balance sheet.

The sliding contact must go.

The double-carbon lamp must go.

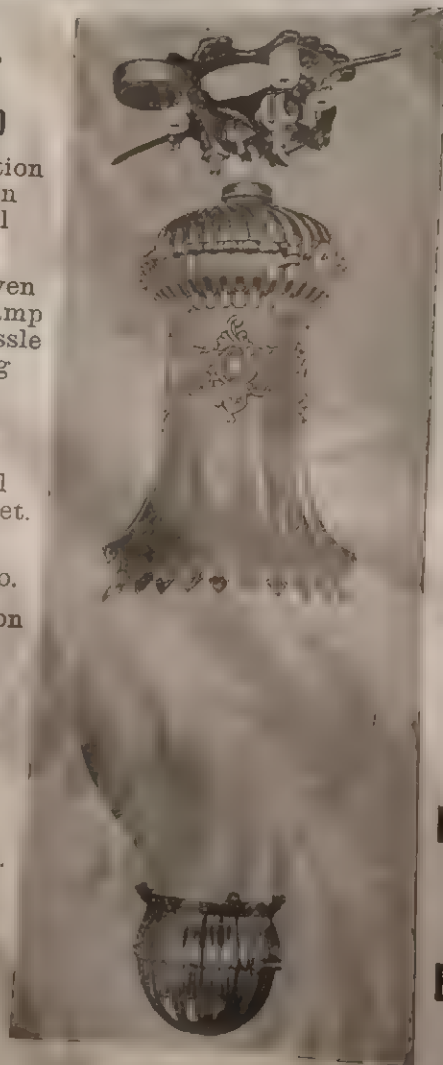
All the springs must go.

All the shadows must go.

The unsightly chimneys must go.

The carbon rod must go.

Wedging carbons must go.



This Lamp Has Come, Consequently All Arc Lamp Difficulties **MUST GO.**



### BE SURE

to read the paper at the Convention on "The Evolution of the Arc Lamp."

### BE SURE

to see our exhibit at the Exposition.

**THE ADAMS-BAGNALL ELECTRIC CO.,**  
.... CLEVELAND. ....

NEW YORK OFFICE, 222 HAVEMEYER BUILDING.



# SAWYER-MAN ELECTRIC CO.

The Board of Directors of the Sawyer-Man Electric Company have much pleasure in announcing that the Company has been reorganized and that the manufacture of the Sawyer-Man incandescent lamp has been resumed. This, no doubt, will be welcome news to every user of incandescent lamps in this country for the reason that for economy, long life and efficiency, the Sawyer-Man incandescent lamp never had a superior on the market.

LIST OF OFFICES TO THE FOLLOWING OFFICES OF THE COMPANY

NEW YORK 20 Broadway & 5 W 23d St	TACOMA WASH 42 So 5th St	PHILADELPHIA Girard Bldg	SYRACUSE N Y Gastable Bldg
BOSTON Exchange Bldg	ALLEGHENY PA Robinson St	ST LOUIS American Central Bldg	SAN FRANCISCO Mills Bldg
CHICAGO New York Life Bldg	BUFFALO Erie County Bank Bldg	CHARLOTTE N C 16 36 College St	WASHINGTON D C 333 F St N

## Westinghouse Electric AND Manufacturing Co.

### PITTSBURG, PA.

MANUFACTURERS OF

STANDARD SYSTEMS FOR ELECTRIC LIGHT AND POWER DISTRIBUTION  
IN CITIES, FACTORIES, MILLS AND MINES.

THE TESLA POLYPHASE ALTERNATING SYSTEM OF ELECTRICAL TRANSMISSION, BY WHICH POWER, INCANDESCENT AND ARC LIGHTING MAY BE OPERATED FROM SAME CIRCUITS.

THE WESTINGHOUSE ELECTRIC RAILWAY SYSTEM, WHICH IS THE MOST DURABLE, ECONOMICAL AND EFFICIENT ON THE MARKET.

## SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA,

Siemens & Halske: Berlin, Charlottenburg, Vienna, St. Petersburg.

MANUFACTURERS OF

DIRECT CURRENT SLOW SPEED MULTIPOLAR GENERATORS AND MOTORS.

These machines are built to the highest standards of efficiency and are in use in all the most important industrial and commercial plants in America and Europe for lighting and power distribution.

ADVANTAGES OF OUR EXTERNAL ARMATURE TYPE.

Maximum Peripheral Speed of Armature with Slowest Engine Speed.  
Shortest Possible Winding of Armature.  
Lowest Internal Resistance of Armature.  
Only 3 to 4 Volts Difference of Potential between Commutator Bars.  
Greatest Weight of Copper per Ampere of Current.  
Greatest Radiating Surface Possible.

Maximum Magnetic Effect.  
Armatures Cannot Burn Out.  
Great Compactness.  
Correct Mechanical Design.  
Finest Quality of Iron.

These machines are built to the highest standards of efficiency and are in use in all the most important industrial and commercial plants in America and Europe for lighting and power distribution.

SEE OUR NEW CATALOGUES CORRESPONDENCE SOLICITED.

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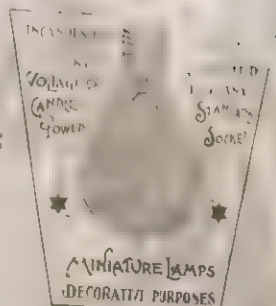
NEW YORK American Express Building and 100 Liberty St	DENVER Oak Street Bldg	SALT LAKE CITY Kimball Hotel Building
CINCINNATI Peck Building	ST LOUIS Bank of Commerce Building	SAN FRANCISCO 10 Front St
MINNEAPOLIS 740 Second Avenue, South		







Single and Multiphase Alternating-Current Apparatus.



Multipolar and Bipolar Direct-Current Dynamos

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APPARATUS FOR  
ARC, DIRECT CURRENT AND ALTERNATING  
INCANDESCENT LIGHTING AND POWER  
TRANSMISSION.



In preparing this new catalogue we have been mindful of the needs of all our customers, and we have endeavored to provide them with the most complete and reliable information possible. We have included in this catalogue the latest and most improved designs of our various electrical appliances, and we have also included a complete list of our various electrical supplies and materials. We hope that this catalogue will be of great value to our customers, and we are sure that it will be well received by all who are interested in the electrical industry.

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RECEIVE A COPY

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100 N. 7TH AVENUE, CHICAGO.

### WESTON Electrical Instrument Co.,

114-120 N. 11th St., NEWARK, N. J. U. S. A.

Illuminated Dial  
Station  
Instruments.

These instruments are  
designed for use in  
the laboratory and in  
the field. They are  
of the most accurate  
and reliable design,  
and are of the most  
modern construction.  
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durable and reliable  
design, and are of the  
most modern construction.



Weston also has illuminated  
dial instruments for use  
in the field.

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These instruments are  
designed for use in  
the laboratory and in  
the field. They are  
of the most accurate  
and reliable design,  
and are of the most  
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durable and reliable  
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### ROOT Improved WATER TUBE BOILER.



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ABENROTH & ROOT MFG. CO., 28 CLIFF STREET, NEW YORK



# ILLUSTRATED ELECTRICAL REVIEW

*A Journal of Scientific and Electrical Progress.*

VOL. 25, No. 21, WEEKLY. NEW YORK, WEDNESDAY MAY 6, 1906. 53 PER ANNUM Single Copies 10 Cents

**VIEWS, NEWS AND INTERVIEWS.**  
Many of the readers of the ELECTRICAL REVIEW will remember the projector which Mr. H. H. Rogers installed on top of the Pulitzer Building, in New York city, to throw portraits and advertising signs on the clouds. In speaking of this apparatus the other day, Mr. Rogers stated that the apparatus was all right, but that it couldn't work without clouds. He waited 40 days in New York for a cloud to show up, and then when it came it was so thin the sign went right through it. Mr. Rogers received, a short time ago, an offer from the Russian state office to install his projector on the top of the Kremlin. Mr. Rogers declined the offer, saying that he did not want to go to Moscow to see the czar. He said Mr. Rogers' company had been there before.

The death of H. H. Rogers, editor of the ELECTRICAL REVIEW, was a great loss to the electrical profession. Mr. Rogers was a man of great energy and ability, and his death was a great blow to the industry.

Mr. H. L. Shippey, secretary of the Edison Association, has been elected an associate member of the American Institute of Electrical Engineers. Mr. Shippey is a well-known electrical engineer and has been active in the promotion of the Edison system of power distribution.

I formed of Mr. Leonard the opinion that he was as sincere, honest, upright and straight as any man I ever knew. I formed the highest opinion of his integrity and probity. For the Jews Mr. Shippey had little good to say. "They are sneaky fellows, who would as soon stab you in the back as not," he declared. "I didn't like them at all. They make English speaking people as uncomfortable as they can all the time. They are overbearing, arrogant and not to be trusted." Traveling from Cape Town.



View of the machine in the factory.

Mr. H. L. Shippey, secretary of the Edison Association, has been elected an associate member of the American Institute of Electrical Engineers. Mr. Shippey is a well-known electrical engineer and has been active in the promotion of the Edison system of power distribution.

The Jacques Carbon Generator is a new invention for the production of carbon. It is a simple and efficient device that can be used in a variety of industrial applications.

As already announced in the ELECTRICAL REVIEW an unfortunate accident happened last week to Prof. F. H. ...

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THE ELECTRIC POWER CO. OF NEW YORK CITY, NEW YORK







TESLA'S IMPORTANT ADVANCES.

HIS REMARKABLE ACCOMPLISHMENTS IN VARIOUS TESTS.

A representative of the *Electrical Review* visited the laboratory of Mr. Tesla last week and found him engaged in putting the final touches to certain improvements in vacuum-tube illumination. He was enthusiastic as to the results arrived at to such a degree that he expressed his positive confidence as to having made very important advances.

When reluctant to speak at present on the subject of his most recent investigations, he authorized the statement to the effect that he has been most successful in several lines of work he has been following up for a long time, only temporarily interrupted by the lamented destruction of his laboratory by fire about a year ago.

When asked about his often-mentioned fluoroscope he said that a commercial machine is now being completed which he expects to show superior to all of this mode of producing electricity.

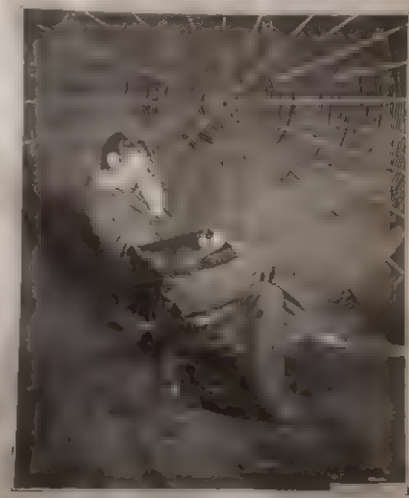
He further stated with evident pleasure that he has been able to produce so much light that he is now able to produce through an Edison improved incandescent lamp recently purchased to test with & compare it with the new method. He said that he has been able to produce light of a much higher intensity than that of the ordinary incandescent lamp.

As to his continuous efforts to improve his system of light, he said that he has been able to produce light of a much higher intensity than that of the ordinary incandescent lamp. He said that he has been able to produce light of a much higher intensity than that of the ordinary incandescent lamp.

A remarkably accurate test of the results of his various experiments was made last week by the light of his new method. He said that he has been able to produce light of a much higher intensity than that of the ordinary incandescent lamp.

Recently shown in the reproduction on this page. The photograph was made by Louis B. & Company, artists' photographers who aided Mr. Tesla in his attempt to photograph by the light of phosphorescent tubes about two years ago.

When asked, Mr. Tesla said, in explanation of the picture, speaking with deep feeling that the volume he was reading was one of the "Scientific Papers" of Maxwell, given to him as a token of friendship by Professor Dewar, the chairman of his warmest friend Mr. E. J. Adams; and as to the queer con-



TESLA'S FLUOROSCOPIC LIGHT. The photograph was made by Louis B. & Company, artists' photographers who aided Mr. Tesla in his attempt to photograph by the light of phosphorescent tubes about two years ago.

He said that he has been able to produce light of a much higher intensity than that of the ordinary incandescent lamp. He said that he has been able to produce light of a much higher intensity than that of the ordinary incandescent lamp.

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General Electric Company's Annual Meeting.

The annual meeting of the General Electric Company was held at Schenectady, N. Y., on May 12. The representation of stock was 201,000 shares. George Foster Peabody was elected a director in place of Thomas K. Cummings, Jr. The balance of the old board of directors was re-elected. Only routine business was transacted and the question of capital impairment was not discussed.

The meeting was held at the Schenectady Hotel. The attendance was large. The business was transacted in a few minutes. The question of capital impairment was not discussed. The meeting was held at the Schenectady Hotel. The attendance was large. The business was transacted in a few minutes. The question of capital impairment was not discussed.

Mr. W. L. Langley, of New York, was elected a director. The meeting was held at the Schenectady Hotel. The attendance was large. The business was transacted in a few minutes. The question of capital impairment was not discussed.

THE DESIRABILITY OF A STANDARD SOCKET.

TOPIC FOR DISCUSSION AT THE MEETING OF THE NATIONAL ASSOCIATION OF ELECTRICAL ENGINEERS, HELD AT NEW YORK, MAY 12-13, 1906.

What a well-known topic for discussion at the meeting of the National Association of Electrical Engineers, held at New York, May 12-13, 1906. The topic was the desirability of a standard socket.



Ad. . . . . D. *Street Journal* recently, and stated  
l to that negotiations had been under way



TESLA IN HIS LABORATORY—PORTRAIT OBTAINED BY AN EXPOSURE OF TWO SECONDS TO THE LIGHT OF A SINGLE VACUUM TUBE WITHOUT ELECTRODES, HAVING A VOLUME OF ABOUT 90 CUBIC INCHES, GIVING APPROXIMATELY A LIGHT OF 250 CANDLE-POWER—PHOTOGRAPHED BY TONNELÉ & CO. COPYRIGHTED BY THE "ELECTRICAL REVIEW."









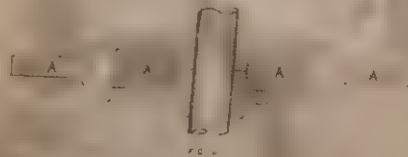
# Electric Light Convention Supplement ELECTRICAL REVIEW

## SOIL ACCOUNT OF THE EVOLUTION OF THE INDUCTOR ALTERNATOR

THE EVOLUTION OF THE INDUCTOR ALTERNATOR



THE EVOLUTION OF THE INDUCTOR ALTERNATOR



HOLMES 1888  
AA INDUCTOR PILES  
AA EXOTIC LINES

THE EVOLUTION OF THE INDUCTOR ALTERNATOR

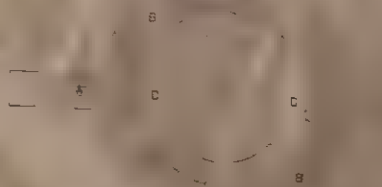
THE EVOLUTION OF THE INDUCTOR ALTERNATOR



HOLMES 1888  
AA INDUCTOR PILES



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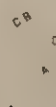
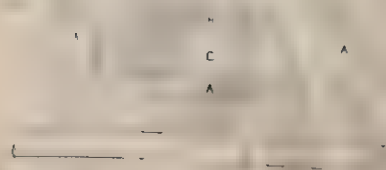


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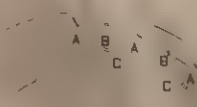
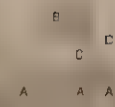






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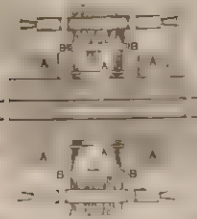


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$$T_{\text{H}^+}$$
  
 $\alpha$   $\beta$   $\gamma$   $\delta$   $\epsilon$   $\zeta$   $\eta$   $\theta$   $\iota$   $\kappa$   $\lambda$   $\mu$   $\nu$   $\xi$   $\omicron$   $\pi$   $\rho$   $\sigma$   $\tau$   $\upsilon$   $\phi$   $\chi$   $\psi$   $\omega$ [illegible]

There is a great deal of evidence to suggest that the use of the word "accrued" is not appropriate in this context. The word "accrued" is typically used to describe a benefit or advantage that has been earned or accumulated over time, such as interest on a loan or a pension benefit. In this case, the benefit is not earned or accumulated over time, but is a result of a specific event (the death of the insured). Therefore, the word "accrued" is not the best choice for this context. A more appropriate word might be "received" or "obtained".



w = the space between the two lines, and  $\alpha$  = the angle between the two lines.  
 If the lines are not parallel, then the area of the parallelogram is  $w \sin \alpha$ .  
 If the lines are parallel, then the area of the parallelogram is  $w$ .  
 Thus, the area of the parallelogram is  $w \sin \alpha$  if the lines are not parallel, and  $w$  if the lines are parallel.

[illegible]





the excessive amounts of coal used in these plants is considered a remarkable

the excessive amounts of coal used in these plants is considered a remarkable

$\frac{d}{dt} \left( \frac{\partial L}{\partial v_i} \right) = \frac{\partial L}{\partial x_i}$

For every pound, he knows that a delivery of inferior coal will be detected once and it will cost him a customer.

...such a man is too apt to be misled by the words of the talker, or the one who tells him last, and in the end pretty sure to make a serious

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which is used for electrical smelting, and it is a graphite pencil or rod.

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Mr. Frank H. Stewart, of Frank H. Stewa & Company, the carpet house, of Philadelphia, has been in New York several days this week.

The offices of the Valentine-Clark company, 17 Chicago, dealers in police for overhead wiring, have been moved from the Hookery to 204-5 (first floor) ng, 210 La Salle street, Chicago.

W R Ostrander & Company  
Manufacturers of  
Stable goods have  
22 Broadway, New York

... Prospective for this...  
... tubes will find it to the...  
... to communicate with the...

The Electric Appliance Company's complimentary duplicate order book advertising scheme has produced a big response and has been a big success.

the Goubert Manufacturing Com-

1.  $\frac{1}{2}$   $\frac{1}{2}$   
 2.  $\frac{1}{2}$   $\frac{1}{2}$   
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 10.  $\frac{1}{2}$   $\frac{1}{2}$

$\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$

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THE G. B. S. ELECTRICAL WEEKLY IN THE UNITED STATES.

# ESTABLISHED ELECTRICAL REVIEW

*A Journal of Scientific and Electrical Progress*

**BEACON LAMPS**  
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The Beacon Lamp Company  
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Bare and Insulated Electric Wire.



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LEONARD F. REQUA, General Manager



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# ILLUSTRATED ELECTRICAL REVIEW

A Journal of Scientific and Electrical Progress.

VOL. 29, No. 7  
WEEKLY  
NEW YORK, WEDNESDAY, AUGUST 17, 1900  
\$3 PER ANNUM  
Single Copies, 10 Cents  
Published at 101 West New York at No. 101 West New York

## VIEWS, NEWS AND INTERVIEWS

A few days ago, a lady in a Rhod. Island dress, who had been on the road was asked to give an interview. It was a very short one, but it was interesting. She said that she had been to the fair and had seen a lot of things. She also said that she had been to the fair and had seen a lot of things.

It was on a Sunday street car that I saw a lady who was very interesting. She was a Rhod. Island dress and she had been on the road. She was asked to give an interview and she said that she had been to the fair and had seen a lot of things. She also said that she had been to the fair and had seen a lot of things.

In last week's issue, I saw a lady who was very interesting. She was a Rhod. Island dress and she had been on the road. She was asked to give an interview and she said that she had been to the fair and had seen a lot of things. She also said that she had been to the fair and had seen a lot of things.

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Edwards' New Induction Coil

Each of the four large coils, which are arranged in a square, is connected to a common terminal. The machine is very ornate and has a large flywheel. It is a very interesting piece of machinery.

## Edwards' New Induction Coil

The new induction coil, designed and constructed by Messrs. L. W. Edwards & Co., of New York, is a very interesting piece of machinery. It is a very ornate and has a large flywheel. It is a very interesting piece of machinery.

## A New Illuminant

The new illuminant, which is a very interesting piece of machinery, is a very ornate and has a large flywheel. It is a very interesting piece of machinery.





[illegible]





Edison Illuminating

NATIONAL ELECTRIC LIGHT

ELECTRICAL REVIEW

T. F. Sullivan,  
Edgar, Boston,  
et, Samuel Hall,  
Hart, W. S. Bar-

Y. A. A.  
G. M. F. J.  
D. A. W. A.  
A. J. M. A.  
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## ELECTRICAL REVIEW

## ON HYPERPHOSPHORIC SCIENCE

he recent researches of I. C. T. K. V. T. J. S. M. A. N. which yet unquestionably consist of transverse vibrations, are of great importance; that any experiments upon the same line, however incomplete, are of interest to physicists.

In January last the writer and his wife visited Mr. Miles Walker were

[illegible]

1. *Chlorophyll a* (Chl a) and *Chlorophyll b* (Chl b) are the two main photosynthetic pigments in green plants. They are responsible for capturing light energy and converting it into chemical energy through the process of photosynthesis. Chl a is the primary pigment, while Chl b acts as an accessory pigment, transferring energy to Chl a.

[illegible]

## Assignment of M. E. &amp; C. Baxter

[illegible]

### MANUFACTURING NOTES

[illegible]



August 12, 1915

POLICE AND THE TELEGRAPH

A NATIONAL ASSOCIATION TO BE FORMED BY SEPTEMBER 15—LYN, IN THE CASE

Away back in the dim mists of antiquity, and at a more remote date than the tentative memory of the oldest inhabitant, some one suggested that in his judgment the superintendents of police and fire telegraph bureaus of the United States and Canada should meet once a year for consultation, enjoy a good dinner and conduct themselves as gentlemen.

It was a good idea, and it was carried out. The first meeting was held the subject was first cooked upon with suspicion by his fellow workers, was then taboos and eventually passed into a nameless grave. It remained, however, for Mr. F. C. Mason, superintendent of the police telegraph system of Brooklyn, N. Y., to start the ball rolling. He did so in a most effective manner, and the result was that the first meeting of the association was held in New York City, on the 15th of September, 1914.

Lecture were sent to the telegraph superintendents of the leading cities of the United States, and suggestions were made as to the subjects to be discussed. The first meeting has been held for Brooklyn, N. Y., on the 15th of September, 1915, and the following are the subjects to be discussed:

1. The present state of the telegraph system in the United States.  
2. The future of the telegraph system in the United States.  
3. The present state of the telegraph system in the United States.

4. The future of the telegraph system in the United States.  
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10. The future of the telegraph system in the United States.  
11. The present state of the telegraph system in the United States.  
12. The future of the telegraph system in the United States.

ELECTRICAL REVIEW

83

ROENTGEN RAYS OR STREAMS

By J. J. Thomson

Chief, F. D.

St. Paul, Minn. Thos. Carey,

Superintendent, Police.

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Superintendent, Police.

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ELECTRIC RAILWAY NOTES

By J. J. Thomson

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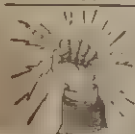


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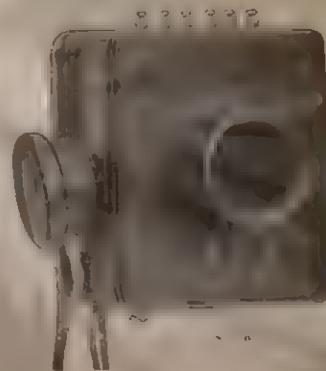
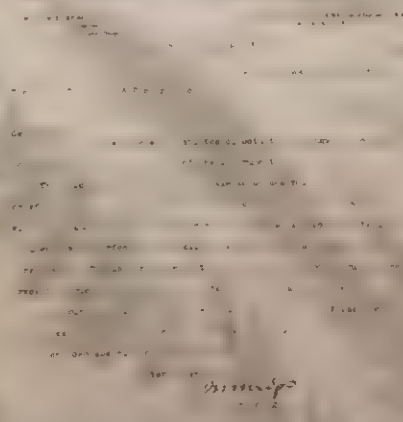
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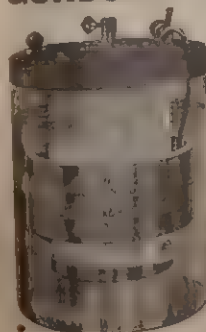
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*A Journal of Scientific and Electrical Progress.*

VOL. 29 No. 23  
WEEKLY

NEW YORK WEDNESDAY DECEMBER 2, 1896

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## VIEWS, NEWS AND INTERVIEWS

In the early part of the year, the public mind was filled with the idea of a new era in the history of the world. The great question of the day was, "What is the future of the world?" The answer was, "The future of the world is in the hands of the people." The people are the great power of the world, and they are the only power that can bring about a new era in the history of the world. The people are the great power of the world, and they are the only power that can bring about a new era in the history of the world.

A resident in Park Row, New York, who has been in the city for some time, has been very much interested in the progress of the city. He has seen the city grow from a small village to a great metropolis. He has seen the city become a great center of commerce and industry. He has seen the city become a great center of science and art. He has seen the city become a great center of the human race.

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A Trolley Man-of-War

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This latest communication will particularly interest the readers of the *Journal* in view of the numerous suggestions and important information it contains.

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The objectives of the plan are to  
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THE UNIVERSITY OF CHICAGO

— a four-week holiday in the summer. The Bank's earnings decreased some 4 per cent in 1934, but last week it is still a credit of about \$1 million a year. The Associates Bank of New York is not a case of this kind. It has a capital of \$10 million in loans. Some \$1 million of this is in loans which have been sold to a firm, a bank or a fund for that matter, in payment. Prices of stocks are the highest in the new atmosphere. Money is plentiful and, consequently, it is a good time to borrow. The new government has a very high rate of interest. It is the first time in the history of the country that the rate of interest has been so high. The result is that the rate of interest is the highest in the history of the country.

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some useful information

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streams it would, therefore, seem very

important to find a method of filter-

ing and rendering them homogeneous,

for only by such a method can

we hope to obtain exact results in

their investigation. Streams of per-

fectly uniform velocity and character,

if produced, would no doubt be more

suitable for the purposes of research

Since the disintegration of the el-

trodes, especially if they are of

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would depend chiefly on the velocity

in the practical use of the Roentgen

streams it would, therefore, seem very

important to find a method of filter-

ing and rendering them homogeneous,

for only by such a method can

we hope to obtain exact results in

their investigation. Streams of per-

fectly uniform velocity and character,

if produced, would no doubt be more

suitable for the purposes of research

Since the disintegration of the el-

trodes, especially if they are of

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described in one of  
[See ELECTRICAL

7. The following table shows the number of people who attended the concert in each age group.

$\frac{1}{\sqrt{2}} \begin{pmatrix} 1 & i \\ 0 & 1 \end{pmatrix}$

[illegible]

feet can be found at the  
 e. I can find it in the app  
 at the of the first story of the  
 and the first of the night

Ich bin ein ...  
Ich bin ein ...  
Ich bin ein ...  
Ich bin ein ...

[illegible]

The ...  
a ...  
the ...  
the ...  
the ...

1. The first of these is the fact that the  
 2. said to be the first of the type  
 3. to be of the type of the  
 4. general made for the purpose of the  
 5. work of the

such a value that the re-ate has  
of the test, I give  
to the attend

most abundant. To produce the best results, that both of these causes should be made to co-operate by a careful proportioning of the materials in bulk, which

the great advantage of the coil which consists in its being capable of giving a high voltage through the secondary for a long

upon the ... of the ...

[illegible]

... was peace. I sent a...

place, he said, that a certain distance, rough the

indicated by the type of  
... exactly in the way it  
... in applying the ...  
... to location of ...

and year apparently without

[illegible]

I am writing to inform you that the  
 following information is being provided to you.  
 This is a copy of the information that  
 was received from the source.  
 The information is being provided to you  
 for your information only.

because I am not, and why I am  
not, and how I am, and how I am,  
and how I am, and how I am,  
and how I am, and how I am,

... will be ... who ...  
... with ... the ...  
... only ... strike ...  
... as ... at ...

the more I will be ready to refer to that, be any of the children

The Roitz screen is first applied to the only investigation of the cause of the formation of the...

eat. But as the sun is  
rising, the pressure goes down  
and the temperature is  
as fresh as the bright

...the direct ...  
...that will ensure  
...strengthening of the  
...economic ...

be  
he  
-d

Mr. Cornelius Mack Gt

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**CONNECTORS AND TERMINALS.**  
Special Connectors for HARD RAYS, 1926  
Wire & No. 14

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PATENT SOLICITORS  
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WASHINGTON, D. C.  
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 Atlantic Building

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Electrical Repair Men  
Teller Lincoln  
Judge Leo P. Barker

\_\_\_\_\_

▲

[illegible]

to a maximum, this velocity is also the highest velocity to the extent that the rays are subjected to the most intense rays. But at this degree of exhaustion it may happen, and usually does happen, that the cathode rays are not so abundant. To produce the best result it is necessary that both of these causes should be made to cooperate in a careful proportioning of the dimensions of the tube. In this practice, is very difficult, inasmuch

the experimenter has to avail him-  
self of commercial bulbs which may  
or may not be best suitable for his  
purpose. The consideration of a  
number of the bulbs of the same  
type is capable of giving a more accurate  
reading through the secondary far more  
than what even the largest laboratory  
bulb can give. Assuming the physicist has  
arrived at a method of manipulation  
to his advantage, he will not be able  
to fear a doubt that he has  
arrived at the truth. The  
experimenter is not a student, he  
is a man of science, and he is not  
a student of science, he is a  
man of science.

[illegible][illegible]

... bluish white at  
the base of the body,  
observe the mass of  
cellular, indurated men-

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PATENT SOLICITORS,  
36 WALL STREET, N.  
Y.  
Have done all my patent work  
and look for them and foreign coun-  
tries for the best facilities.  
Wm. Thomas & Pilsbury

**AGENCY.** LARGEST  
WORLD  
908-914 C Street, N. W.  
WASHINGTON, D. C.  
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EX

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Geo. R. (loop.

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Attorneys and Counsellors a  
Patents and Trade Marks  
Atlantic Bu

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Representative [Name] from [State] was [Action] [Topic] [Location] [Date].

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Now, some all my patients and

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1900

## Atlantic Bulldozer

[illegible]

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[illegible]

of **EDW. S. DUFFALL,** Loan and Trust  
Sole Agent of Patents



# Kindred... ...Interests

The Kent Electric Manufacturing Company, Worcester, Mass., has issued a neat catalogue illustrating and describing its alternating-current motors, battery motors and light power specialties.

G. A. Frei & Company, 17 Bromfield street, Boston, Mass., have recently prepared a very satisfactory and complete catalogue of their X-ray supplies, which also contains a number of flattering testimonials to the merit of their products.

The Electric Appliance Company, Chicago, report a splendid lamp business during the months of October and November. The Pack and lamp not only holds its own, but gains ground every year in a way that indicates clearly that it is made of the right kind of stuff and has lasting merit.

McKenney & Waterbury, Boston—Large contracts for gas and electric fixtures received a past week. McKenney & Waterbury's contract includes the City Hospital building, Massachusetts Benefit Association building, State street; Storage Warehouse, Long Huntington street; Old Fellows building, Gardiner, Me.; Fitch's Normal School, and the South Congregational Church, Concord, N. H. This firm is the largest in the business in New England.

The Phillips Insulated Wire Company, Pawtucket, R. I., are sending out a remarkably handsome and complete price list, as well as carefully prepared samples of their standard weatherproof wire, and their new and ideal wire, all of which they make in addition to their celebrated "K" weatherproof insulated wire. They are calling special attention to their white wire, with black insulation and white fireproof outer finish. This latter wire is especially for exposed work where a good white finish is desired.

Probably no other among the many large concerns located in the city of New York is the author of the new and best of all the "The Manufacturers Advertising Bureau." This bureau was established in 1890, and is now the largest and most complete of its kind in the world. It is a publisher of the "Manufacturers Advertising Bureau," and is the only one of its kind in the world. It is a publisher of the "Manufacturers Advertising Bureau," and is the only one of its kind in the world. It is a publisher of the "Manufacturers Advertising Bureau," and is the only one of its kind in the world.

## ELECTRICAL REVIEW

Recent location of the Manufacturers' Advertising Bureau—120 Liberty street is an admirable one, and affords the best of facilities for transacting the business in a satisfactory and expeditious manner.

### FOR SALE

Two 1000 generators, latest type, complete equipment.  
Ten 500 P. 20 motors all in first class condition for service.  
Four 1000 P. 20 motors, used three months.  
Four 500 P. 1000 generators, brand new.  
Two 1000 P. 100 generators, in perfect condition.  
300 arc lamps of various makes, cheap.

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Worcester, Mass.

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16,000 telephone stations in New York City

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A Sample will be Sent for 10c.

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On Dixon's Commutator Lubricant, Jersey City, N. J. Testimony: The sample of Dixon's Commutator Lubricant was required, and in giving nature and description. It is considered by our engineer superior to any thing else he has ever seen. It is a great success. Dixon's Commutator Lubricant, Jersey City, N. J.

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MANUFACTURERS OF ANNUNCIATORS  
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DEAD OIL OF COAL TAR PROCESS.  
CREOSOTED PILES AND TIMBER FURNISHED.

**VALENTINE SUBWAY ELECTRICAL CONDUIT.**  
LARGEST PLANT IN THE WORLD.  
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MAKERS OF  
Electric Light Carbons Soft-Cored and Solid Carbon Brushes. Battery Carbons and Carbon Specialties.

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**I-T-E CIRCUIT BREAKERS** are the accepted standard.  
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PENACOOK, N. H., U. S. A.

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**BRILLIANT, STEADY and EFFICIENT LIGHT FOR ALTERNATING AND DIRECT CURRENT.**  
**SCHIFF, JORDAN & CO.,**  
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39-41 GORTLANDT ST.,  
NEW YORK.

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## ELECTRICAL REVIEW

## ADVANCE INFORMATION

Valuable News and Tips for Manufacturers and Dealers

We publish below information relating to new electric railways, new electric light companies, new telephone companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching the department in the ELECTRICAL REVIEW.

## Electric Light and Power.

**BILLINGS FALLS, MT.**—The Western Electric Company has been incorporated by George O. Guild, Benjamin B. Washburn, Charles K. Labaree and others, for the purpose of establishing an electric plant at Westminister, in Windham County. Capital stock, \$50,000.

**PITTSBURGH, PA.**—Joseph J. Dehaene can give information concerning proposed construction of good municipal plant.

**ST. LOUIS, MO.**—Motor Manufacturing can give information concerning establishment of electric light plant to be built and operated by the city.

**CHICAGO, ILL.**—H. M. J. Ward & Company are interested in proposed construction of electric light plant.

**CINCINNATI, OH.**—The plant will be constructed at a cost of \$12,000. They are in the market for the necessary machinery.

may give information concerning the establishment of proposed electric light plant.

**HARDWIKE, VT.**—The light plant is rapidly approaching completion.

**JACKSONVILLE, FLA.**—A. P. Waller, of the Spring Electric plant, will give information necessary for the completion of the electric light plant at St. Petersburg.

**BEAVER FALLS, PA.**—Barre Electric Light and Power Company has been incorporated by Frank G. Howland, H. K. Bond, W. A. Parry, Geo. J. Reynolds. Capital stock, \$150,000.

**PORT WORTH, TEX.**—Standard Light and Power Company has been incorporated by John C. Harrison, W. B. Harrison, George E. White, R. I. White. Capital stock, \$100,000.

**YONKONTO, ONT.**—A new electric light plant is to be established.

**FARMINGTON, MASS.**—It is reported that Mr. J. S. of this place, will erect an electric light plant.

**RIVERSIDE, CAL.**—The City Trustees are now studying the matter of installing a better system of electric lighting in the city, and it is expected that a new system will be installed.

**LOS ANGELES, CAL.**—The West Side Electric Company has been incorporated.

**Directors are M. E. Peck, E. F. Billmeyer, of Los Angeles, George H. Baker, W. R. Stants and Walter S. Wright, of Pasadena.**

**BEAVER FALLS, PA.**—The charter of the Valley Electric and Light Company has been entered for record in the Recorder's office. The incorporators are Wm. A. McGool, president, Hunter Eckert, secretary; H. M. Rees, treasurer; A. S. Reeves and J. A. Breuner. The latter two are of Philadelphia. The company is capitalized at \$3,000.

**SOUTHBRIDGE, MASS.**—Agitation of the subject of lighting the town by electricity is started, and the Southbridge electric plant has it under consideration.

**SAN FRANCISCO, CAL.**—There is more than a probability that a portion of this year's appropriation for Golden Gate Park will be used for the purpose of lighting the park with electricity.

**OPHIR, COLO.**—Final plans are about completed for a system of electric lighting for this place. The power will be furnished by the Dunn power plant at Arica.

**MILWAUKEE, WIS.**—An electric light plant, to cost \$3,000, is to be erected here.

## New Electric Railways.

**POLTER, VT.**—The Western Vermont Street Railway Company applied for articles of incorporation to operate a street railway in the town of Middletown Springs, Polter, etc. Incorporators are Leonard Gray, A. Y. Gray, A. A. Greene, A. H. Varney, J. B. Beaman, E. H. Phelps and Jerome B. Bromley. Capital stock, \$100,000.

**KANSAS.**—The Pittsburg, Atchafalaya and Columbia Railway Company is now being organized. It is proposed to build a line from Pittsburg to A. Natron, N. M., and then to the Gulf of Mexico. The proposed line is to be constructed by the Pittsburg, Atchafalaya and Columbia Railway Company. Capital stock, \$200,000.

**RACINE, WIS.**—The Milwaukee, Racine and Kenosha Electric Railway Company has been incorporated, to operate an electric street railway system from South Milwaukee, to Jersey through Cudahy and the town of Lake and Oak Creek, then south through the towns of Caledonia and Mount Pleasant, city of Racine and the towns of Somers, Pleasant Prairie

## X-RAY SUPPLIES.

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Photographic Screens.

G. A. PREL &amp; CO.,

17 Broadway Street, BOSTON.

and city of Kenosha. Capital stock, \$200,000.

**NEW YORK, N. Y.**—A permit has been granted to the Third Avenue Rapid Transit Company to extend its tracks from 162d street along Kingsbridge Road and Broadway to Spuyten Duyck Creek, and to use the trolley electric motive power.

**MT. CLEMENS, MICH.**—An ordinance has been introduced in the council granting a franchise to the Detroit, Lake Shore & Mt. Clemens Railroad, to operate an electric railway in this city.

**HAMILTON, ONT.**—A 50-year franchise has been granted to the Cincinnati & Miami Valley Traction Company to operate their lines through the county. Work must be begun by July, 1897.

**PORTSMOUTH, OHIO.**—An electric line from Scioville to New Boston will be built in the Spring.

## New Telephone and Telegraph Companies.

**JACKSONVILLE, MO.**—The Underground Telegraph and Telephone Company, the successor of the Sutter Telephone Company, has been incorporated. Incorporators are Charles Sutter and Emil Mayenberg.

**ELMIGOTT CITY, MD.**—A stock company is being organized in Howard County for the purpose of establishing an extensive telephone system in this county. The proposed line is to connect with the city of Baltimore, and to run through the towns of Elkridge, Ellicott City, and the city of Baltimore. The proposed line is to be constructed by the Elmigott City Telephone Company. Capital stock, \$100,000.

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New and Powerful  
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L. E. KNOTT APPARATUS CO.,

14 ASHBURTON PLACE, BOSTON, MASS.

building a telephone line from the place to North Park is being organized.

the telephone line is being constructed at this place and Warren will, upon its completion, be connected with the lines of the Youngstown Telephone Company, with the exchange of exchanges at Girard and Nile.

## New Manufacturing Companies.

**ST. LOUIS, MO.**—The Electric Bottom Manufacturing Company has been incorporated. Capital stock, \$50,000. Incorporators: Anthony Sittenstein, W. Y. Hopkins and C. M. Najohn.

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\$50,000. Incorporators: Anthony  
Silverston, W. Y. Hopkins and  
C. M. Napton.

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**GENUINE**

...are and Oak Creek, then south  
...through the towns of Caledonia and  
...Oak Creek, then south through the  
...towns of Caledonia and Mount  
...Pleasant, city of Racine and the  
...towns of Somers, Pleasant Prairie

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### **CROOKES TUBES.**

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Stanley's TOEPLER-HOLTZ Machines

will do same work as high-frequency coil at

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*With no Installation or Running Expenses.*

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and ultimately to reach  
Lisbon, Poplar Springs, Mt. Airy,  
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38 Spring Park Avenue,  
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**McKenney & Waterbury,** Boston

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# ILLUSTRATED ELECTRICAL REVIEW

*A Journal of Scientific and Electrical Progress.*

VOL. 30, No. 4, 1  
WEEKLY

NEW YORK, WEDNESDAY, JANUARY 21, 1903

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## VIEWS, NEWS AND INTERVIEWS.

Mr. Andrew Carnegie  
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The Appellate Division of the New  
York State Supreme Court has  
decided that a woman could not  
be a witness in a criminal case  
where the crime was committed  
in the presence of the defendant  
and the witness was a woman.

The City Surveyor, Mr. J. J. J.  
after considering various  
proposals for the improvement  
of the city streets, has decided  
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## Electricity in Paterson, N. J.

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## ELECTRIC LIGHTING IN TASMANIA

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THE NEW POWER PLANT AT PATTERSON, N. J.

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## LIBRARY

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The *effectiveness* of  
law firms

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The following table shows the results of the analysis of variance for the three points.

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The Cricker-Wheeler Installation  
in the New Astor Hotel

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## The Standard Edison Fluoroscope

and Fluorescent Screens.

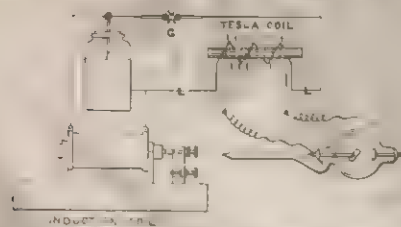
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### X Rays Detect Adulteration

If real time, that's the issue.

## X-RAY APPARATUS AND METHODS

The X-ray apparatus consists of a high voltage source, a transformer, and a vacuum tube. The high voltage source is connected to the primary of the transformer, which is also connected to the anode of the vacuum tube. The cathode of the vacuum tube is connected to ground. The X-rays are produced at the anode.



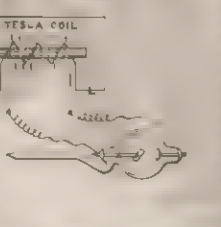
The primary of the transformer is connected to the high voltage source. The secondary of the transformer is connected to the anode of the vacuum tube. The cathode of the vacuum tube is connected to ground. The X-rays are produced at the anode.

The vacuum tube is a vacuum diode. The anode is connected to the secondary of the transformer. The cathode is connected to ground. The X-rays are produced at the anode.

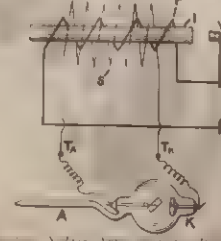
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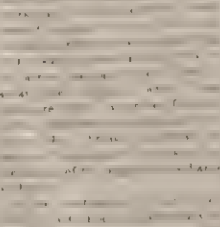


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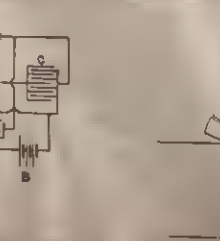


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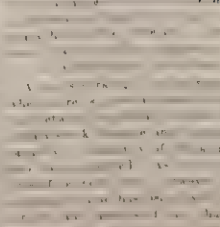


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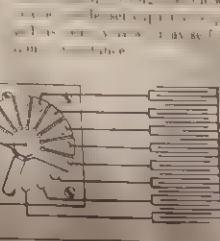


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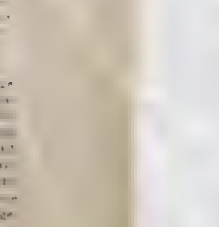


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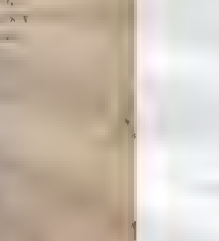


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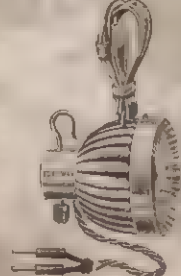
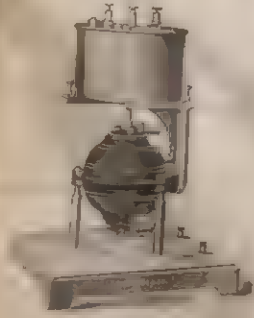
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Presenting a Lecture on the X  
Ray

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THE UNIVERSITY OF CHICAGO

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The "Cat-Eye" Electric Bicycle Lamp

The Edison Company of America  
has made this lamp, and it  
is the best in the world. It  
is made of the best materials,  
and it is the only one that  
will last for a long time.  
It is a lamp of the future,  
and it is the only one that  
will last for a long time.  
It is a lamp of the future,  
and it is the only one that  
will last for a long time.





## PERSONAL

Mrs. Mary Ann ...

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do hereby certify that \_\_\_\_\_  
is a duly qualified \_\_\_\_\_ of the \_\_\_\_\_  
Company of the \_\_\_\_\_ State of \_\_\_\_\_.

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... the eastern express  
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factory space not made

of this company, Mr. L. H. is greatly pleased as he has reason to be, over the success which has attended his business with you.

... and Mr. I. J. Ba... all are  
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### Editors Enjoy a Trolley Ride

The Republican National Association held its annual meeting at New York City on each Tuesday evening last afternoon of last day to a large and enthusiastic audience in the beautiful parlors of the Waldorf. The President of the Brooklyn Street Railway Company presided at the occasion and was very capable as well as novel experience for the evening entertainment of the audience. The city of Brooklyn and suburbs were very much an excellent repast. After the ride they visited the Brooklyn Navy Yard and were later entertained at a banquet at the Union League Club of Brooklyn, through the courtesy of the president of the association, H. William Burr, proprietor of the Brooklyn Standard Union. After dinner speeches at the banquet were of unusual interest and were made by the following eminent gentlemen: Chauncey M. Depew, H. H. Root, Paul Dana, W. J. Arkle, George H. Daniels, Fore, H. Howard L. Henry, W. Peterson and Lucius R. Carey, Jr. N. Y.

### Another Reason Why the Cable Should Go

From New York Evening Sun

If I stand in a car and wave  
my umbrella at a cable car, and  
wails, tell you without slowing  
up, I don't like it. My man up  
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of the mass were injured. It  
was in this way. The an  
front have been doing, best

## A Belt Manufacturer Assigns

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1. Learn steam power  
 2. Learn to use a  
 3. Learn to use a  
 4. Learn to use a  
 5. Learn to use a

$$M_1 = W_{\text{L}} + W_{\text{K L}} + \frac{c}{\gamma} + r_{\text{L}}$$

$M_1$     $W_1$     $W_2$     $W_3$     $W_4$     $W_5$     $W_6$     $W_7$     $W_8$     $W_9$     $W_{10}$     $W_{11}$     $W_{12}$     $W_{13}$     $W_{14}$     $W_{15}$     $W_{16}$     $W_{17}$     $W_{18}$     $W_{19}$     $W_{20}$     $W_{21}$     $W_{22}$     $W_{23}$     $W_{24}$     $W_{25}$     $W_{26}$     $W_{27}$     $W_{28}$     $W_{29}$     $W_{30}$     $W_{31}$     $W_{32}$     $W_{33}$     $W_{34}$     $W_{35}$     $W_{36}$     $W_{37}$     $W_{38}$     $W_{39}$     $W_{40}$     $W_{41}$     $W_{42}$     $W_{43}$     $W_{44}$     $W_{45}$     $W_{46}$     $W_{47}$     $W_{48}$     $W_{49}$     $W_{50}$     $W_{51}$     $W_{52}$     $W_{53}$     $W_{54}$     $W_{55}$     $W_{56}$     $W_{57}$     $W_{58}$     $W_{59}$     $W_{60}$     $W_{61}$     $W_{62}$     $W_{63}$     $W_{64}$     $W_{65}$     $W_{66}$     $W_{67}$     $W_{68}$     $W_{69}$     $W_{70}$     $W_{71}$     $W_{72}$     $W_{73}$     $W_{74}$     $W_{75}$     $W_{76}$     $W_{77}$     $W_{78}$     $W_{79}$     $W_{80}$     $W_{81}$     $W_{82}$     $W_{83}$     $W_{84}$     $W_{85}$     $W_{86}$     $W_{87}$     $W_{88}$     $W_{89}$     $W_{90}$     $W_{91}$     $W_{92}$     $W_{93}$     $W_{94}$     $W_{95}$     $W_{96}$     $W_{97}$     $W_{98}$     $W_{99}$     $W_{100}$     $W_{101}$     $W_{102}$     $W_{103}$     $W_{104}$     $W_{105}$     $W_{106}$     $W_{107}$     $W_{108}$     $W_{109}$     $W_{110}$     $W_{111}$     $W_{112}$     $W_{113}$     $W_{114}$     $W_{115}$     $W_{116}$     $W_{117}$     $W_{118}$     $W_{119}$     $W_{120}$     $W_{121}$     $W_{122}$     $W_{123}$     $W_{124}$     $W_{125}$     $W_{126}$     $W_{127}$     $W_{128}$     $W_{129}$     $W_{130}$     $W_{131}$     $W_{132}$     $W_{133}$     $W_{134}$     $W_{135}$     $W_{136}$     $W_{137}$     $W_{138}$     $W_{139}$     $W_{140}$     $W_{141}$     $W_{142}$     $W_{143}$     $W_{144}$     $W_{145}$     $W_{146}$     $W_{147}$     $W_{148}$     $W_{149}$     $W_{150}$     $W_{151}$     $W_{152}$     $W_{153}$     $W_{154}$     $W_{155}$     $W_{156}$     $W_{157}$     $W_{158}$     $W_{159}$     $W_{160}$     $W_{161}$     $W_{162}$     $W_{163}$     $W_{164}$     $W_{165}$     $W_{166}$     $W_{167}$     $W_{168}$     $W_{169}$     $W_{170}$     $W_{171}$     $W_{172}$     $W_{173}$     $W_{174}$     $W_{175}$     $W_{176}$     $W_{177}$     $W_{178}$     $W_{179}$     $W_{180}$     $W_{181}$     $W_{182}$     $W_{183}$     $W_{184}$     $W_{185}$     $W_{186}$     $W_{187}$     $W_{188}$     $W_{189}$     $W_{190}$     $W_{191}$     $W_{192}$     $W_{193}$     $W_{194}$     $W_{195}$     $W_{196}$     $W_{197}$     $W_{198}$     $W_{199}$     $W_{200}$     $W_{201}$     $W_{202}$     $W_{203}$     $W_{204}$     $W_{205}$     $W_{206}$     $W_{207}$     $W_{208}$     $W_{209}$     $W_{210}$     $W_{211}$     $W_{212}$     $W_{213}$     $W_{214}$     $W_{215}$     $W_{216}$     $W_{217}$     $W_{218}$     $W_{219}$     $W_{220}$     $W_{221}$     $W_{222}$     $W_{223}$     $W_{224}$     $W_{225}$     $W_{226}$     $W_{227}$     $W_{228}$     $W_{229}$     $W_{230}$     $W_{231}$     $W_{232}$     $W_{233}$     $W_{234}$     $W_{235}$     $W_{236}$     $W_{237}$     $W_{238}$     $W_{239}$     $W_{240}$     $W_{241}$     $W_{242}$     $W_{243}$     $W_{244}$     $W_{245}$     $W_{246}$     $W_{247}$     $W_{248}$     $W_{249}$     $W_{250}$     $W_{251}$     $W_{252}$     $W_{253}$     $W_{254}$     $W_{255}$     $W_{256}$     $W_{257}$     $W_{258}$     $W_{259}$     $W_{260}$     $W_{261}$     $W_{262}$     $W_{263}$     $W_{264}$     $W_{265}$     $W_{266}$     $W_{267}$     $W_{268}$     $W_{269}$     $W_{270}$     $W_{271}$     $W_{272}$     $W_{273}$     $W_{274}$     $W_{275}$     $W_{276}$     $W_{277}$     $W_{278}$     $W_{279}$     $W_{280}$     $W_{281}$     $W_{282}$     $W_{283}$     $W_{284}$     $W_{285}$     $W_{286}$     $W_{287}$     $W_{288}$     $W_{289}$     $W_{290}$     $W_{291}$     $W_{292}$     $W_{293}$     $W_{294}$     $W_{295}$     $W_{296}$     $W_{297}$     $W_{298}$     $W_{299}$     $W_{300}$     $W_{301}$     $W_{302}$     $W_{303}$     $W_{304}$     $W_{305}$     $W_{306}$     $W_{307}$     $W_{308}$     $W_{309}$     $W_{310}$     $W_{311}$     $W_{312}$     $W_{313}$     $W_{314}$     $W_{315}$     $W_{316}$     $W_{317}$     $W_{318}$     $W_{319}$     $W_{320}$     $W_{321}$     $W_{322}$     $W_{323}$     $W_{324}$     $W_{325}$     $W_{326}$     $W_{327}$     $W_{328}$     $W_{329}$     $W_{330}$     $W_{331}$     $W_{332}$     $W_{333}$     $W_{334}$     $W_{335}$     $W_{336}$     $W_{337}$     $W_{338}$     $W_{339}$     $W_{340}$     $W_{341}$     $W_{342}$     $W_{343}$     $W_{344}$     $W_{345}$     $W_{346}$     $W_{347}$     $W_{348}$     $W_{349}$     $W$

## The Value-Added Tax on a net

The Adams-Baggett family of  
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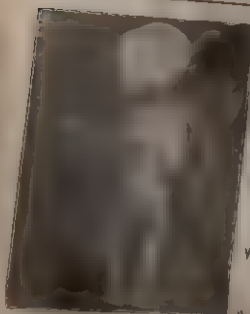
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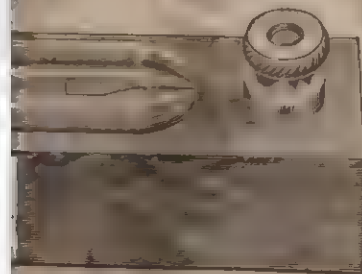
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## ELECTRICAL REVIEW

XI

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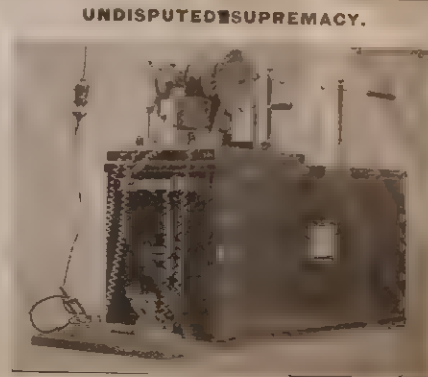
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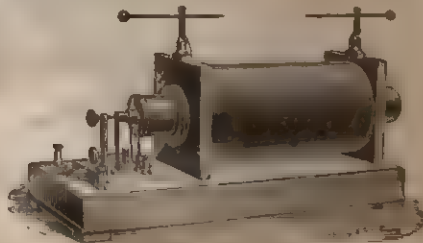
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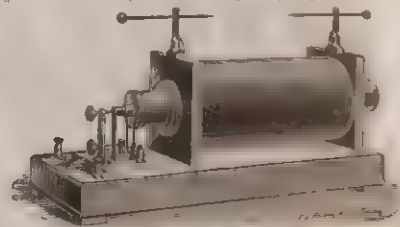
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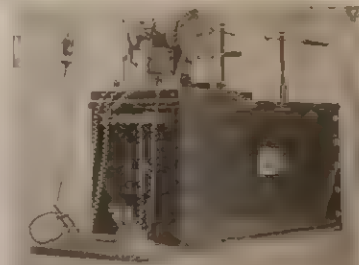
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GREEN & BAUER,

MANUFACTURERS OF THE CROOKES TUBES AND COMPLETE OUTFITS,  
356 ASYLUM STREET, HARTFORD CT

## The Standard Edison Fluoroscopes and Fluorescence Screens, MANUFACTURED BY AYLSWORTH & JACKSON, ORANGE, N. J.



# BRUSH

Brush paint is hot on the market for 25 years. A major customer order for 100,000 lbs. of this material was placed by a large order. Ask for a sample of the product. The price is \$1.00 per lb. for 100,000 lbs. or more.



FIRST BRUSH ARC DYNAMO 1872

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BRUSH MULTI-CIRCUIT 125-LIGHT ARC DYNAMO, 1897.

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The advantages are absolute flexibility in handling of circuits; reduction of high voltages on circuits run from large dynamos; use of large units with corresponding increase of efficiency; saving in floor space, oil, belt, shafting, pulley attendance.



*A Journal of Scientific and Electrical Progress.*

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" LA JORNETTE MU TAINE "

The E. coli outbreak a few short weeks ago, noted the fact that the French customs boys were experimenting with an X-ray apparatus designed to detect flammable liquids concealed about the clothing of a traveler or in sealed packages. The



FRENCH, J. S., CHODURA, E. M., AND SAUER, J. M.  
X RAY ABSORPTION

A press dispatch states that a franchise has been granted to the Hon. Irwin H. Hobbart and associates to construct a line between Colorado Springs, Colo., and Cripple Creek, a distance of 30 miles. The franchise is owned by the new rail-

parted the other day, probably because some craft ran afoul of it. Three men were sent out from the Battery in a rowboat to grapple for the broken ends. They were unable to raise them. Then one of the men, Leon Cholet, who is an expert diver, put on a bathing suit and

the exposures lasted for 10 minutes and resulted in no injury to the skin. In five of the patients only was the treatment persevered with. In two of these, where acute phthisis chanced to be aggravated by the results of alcoholism and poor living, there was no improvement whatever either in the general or the local conditions.



FRENCH CUSTOMS OFFICER INSPECTING A WOMAN'S HAT AND HAIR BY MEANS OF X-RAY APPARATUS.

vanished under water, nearly 25 feet. He made a line fast to one of the broken ends and it was hauled up. He came up for a breathing spell, and then went down and got the other end. The ends were spliced

Three chronic cases of pulmonary tuberculosis showed some amelioration of general condition, but no alteration at the seat of mischief and no arrest of the disease. In three other cases the rays had no appreci-

coming down in pipes from the Beaver lakes, the headwaters of the city system, located on Pike's Peak, at an altitude of 12,000 feet. The city's water will be protected from contamination. Mr. Howebart is in Europe floating the bond necessary for the construction

The ELECTRICAL REVIEW some weeks ago mentioned the fact that the French customs officers were experimenting with an X-ray apparatus designed to detect dutiable articles concealed about the clothing of a traveler or in sealed packages. The



FRENCH CUSTOMS OFFICER EXAMINING A HAND-SACHEL BY MEANS OF X-RAY APPARATUS.

of the road, which will cost \$1,500,000. Work on grading has begun. The proposed road will have grades in places as high as 13½ per cent.

This advertisement recently ap-

accompanying illustrations show this apparatus in an improved form devised by Prof. Gaston Séguy and which recently underwent successful tests at the Pavillon de Rohan and the Gare du Nord. The apparatus



Work in the new plant at Tel-  
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THE GAY NEW YORK

A recent trolley party, under the leadership of Senator George H. Carter, made a round trip from Boston to Worcester, Mass., a distance of nearly 100 miles.

[illegible]

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When the first article was sent to the post office, I was sure it was so good that I expected to see it printed in full in the next issue of the paper. I was quickly disappointed, and it did not appear. I was not able to hear any word of it, and I was sure it had been lost. I was not able to hear any word of it, and I was sure it had been lost. I was not able to hear any word of it, and I was sure it had been lost.

The following table indicates amount of cooking done for breakfast, dinner and supper respectively and may be taken as a fair estimate of the amount used.

The next day, Nov. 3, the market was even. The

| Time | Guest | Room    |
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| 7:45 | No 3  | Room 12 |
| 7:15 | No 4  | Room 13 |
| 7:55 | No 5  | Room 14 |
| 8:05 | No 6  | Room 15 |

Kilowatt hour 1355 com

| Time  | Guest  | Room     |
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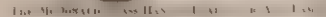


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I am glad  
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I hope you will have a very  
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The new State Telephone Company, of Detroit, Mich., has secured the purchase of the rights of the new exchange in the Detroit Telephone Company, of Lake St. Clair. This company has exchanges at Lake Okauchee and Lehigh and is in connection with the exchanges at Grand Island and Grand Island. The present exchange is located in a large and modern building. The new lines are being laid out and will be a traffic improvement with Detroit Telephone Company.

[illegible]





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[illegible][illegible]

August 11, 1897

# TESLA ON THE SOURCE OF ROENTGEN RAYS AND THE PRACTICAL CONSTRUCTION AND SAFE OPERATION OF LENARD TUBES.

TO THE EDITOR OF ELECTRICAL REVIEW:

I have for some time felt that a few indications in regard to the practical construction of Lenard tubes of improved designs, a great number of which I have recently exhibited before the New York Academy of Sciences (April 6, 1897), would be useful and timely, particularly as by their proper construction and use much of the danger attending the experimentation with the rays may be avoided. The simple precautions which I have suggested in my previous communications to your esteemed journal are seemingly disregarded, and cases of injury to patients are being almost daily reported, and in view of this only, were it for no other reason, the following lines, referring to this subject, would have been written before had not again pressing and unavoidable duties prevented me from doing so. A short and, I may say, most unwelcome interruption of the work which has been claiming my attention makes this now possible. However, as these opportunities are scarce, I will utilize the present to dwell in a few words on some other matters in connection with this subject, and particularly on a result of importance which I have reached some time ago by the aid of such a Lenard tube, and which, if I am correctly informed, I can only in part consider as my own, since it seems that practically it has been expressed in other words by Professor Roentgen in a recent communication to the Academy of Sciences of Berlin. The result alluded to has reference to the

## ELECTRICAL F

will be seen presently, it is not the only source.

Since recording the above fact my efforts were directed to finding answers to the following questions: First, is it necessary that the impact body should be within the tube? Second, is it required that the obstacle in the path of the cathodic stream should be a solid or liquid? And, third, to what extent is the velocity of the stream necessary for the generation of and influence upon the character of the rays emitted?

In order to ascertain whether a body located outside of the tube and in the

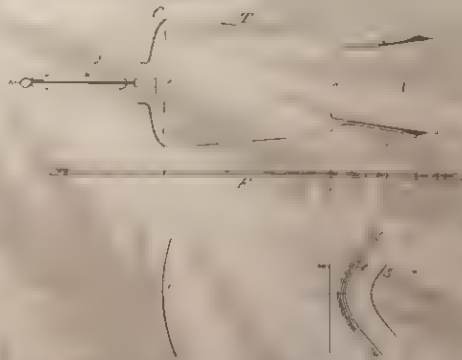


FIG. 1.—ILLUSTRATING AN EXPERIMENT REVEALING THE REAL SOURCE OF THE ROENTGEN RAYS.

path or in the direction of the stream of particles was capable of producing the same peculiar phenomena as an object located inside, it appeared necessary to first show that there is an actual penetration of the particles through the wall, or otherwise that the actions of the supposed streams, of whatever nature they might be, were sufficiently pronounced in the outer region close to the wall of the bulb as to produce some of the effects which are peculiar to a cathodic stream. It was not difficult to obtain with a properly prepared Lenard tube,

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with this subject, and particularly on a result of importance which I have reached some time ago by the aid of such a Lenard tube, and which, if I am correctly informed, I can only in part consider as my own, since it seems that practically it has been expressed in other words by Professor Roentgen in a recent communication to the Academy of Sciences of Berlin. The result alluded to has reference to the much disputed question of the source of the Roentgen rays. As will be remembered, in the first announcement of his discovery, Roentgen was of the opinion that the rays which affected the sensitive layer emanated from the fluorescent spot on the glass wall of the bulb; other scientific men next made the cathode responsible; still others the anode, while some thought that the rays were emitted solely from fluorescent powders or surfaces, and speculations, mostly unfounded, increased to such an extent that, despairingly, one would exclaim with the poet:

"O gluecklich wer noch hoffen kann,  
Aus diesem Meer des Irrtums aufzutauchen!"

My own experiments led me to recognize that, regardless of the location, the chief source of these rays was the place of the first impact of the projected stream of particles within the bulb. This was merely a broad statement, of which that of Professor Roentgen was a special case, as in his first experiments the fluorescent spot on the glass wall was, incidentally, the place of the first impact of the cathodic stream. Investigations carried on up to the present day have only confirmed the correctness of the above opinion, and the place of the first collision of the stream of particles—be it an anode or independent impact body, the glass wall or an aluminum window—is still found to be the principal source of the rays. But, as

required inside, it appeared necessary to first show that there is an actual penetration of the particles through the wall, or otherwise that the actions of the supposed stream, of whatever nature they might be, were sufficiently pronounced in the outer region close to the wall of the bulb as to produce some of the effects which are peculiar to a cathodic stream. It was not difficult to obtain with a properly prepared Lenard tube, having an exceedingly thin window, many and at first surprising evidences of this character. Some of these have already been pointed out, and it is thought sufficient to cite here one more which I have since observed. In the hollow aluminum cap A of a tube as shown in diagram Fig. 1, which will be described in detail, I placed a half-dollar silver piece, supporting it at a small distance from and parallel to the window or bottom of the cap by strips of mica in such a manner that it was not

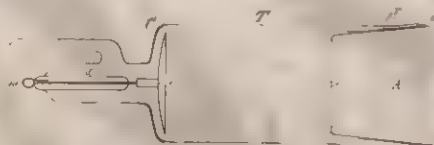


FIG. 2. -IMPROVED LENARD TUBE.

touching the metal of the tube, an air space being left all around it. Upon exciting the bulb for about 30 to 45 seconds by the secondary discharge of a powerful coil of a novel type now well known, it was found that the silver piece was rendered so hot as to actually scorch the hand; yet the aluminum window, which offered a very insignificant obstacle to the cathodic stream, was only moderately warmed. Thus it was shown that the silver alloy, owing to its density and thickness, took up most of the energy of the impact, being acted upon by the particles almost identically as if it had been

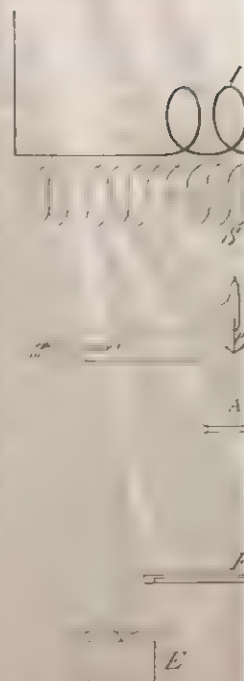


FIG. 3. -ILLUSTRATION WITH IMPROVED DESIGN FOR REDUCING THE THICKNESS OF THE GLASS.

improved design, consisting of thick glass tap open end, or neck fitted an aluminum spherical cathode of glass stem, and sealed in the opposite as usual. The aluminum be observed, is not with the ground-glass held at a small distance by a narrow ring of tin foil. between the glass is filled with cement which I shall later Roentgen screen used in making the Now, in looking up the direction from lines indicated on the diagram were seen in the background.

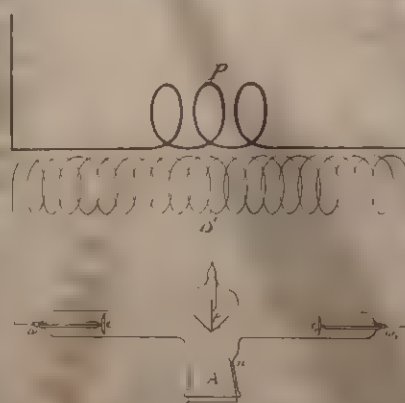
... of the bulb, and, what is more,  
... obtained, by observ-  
... shadows, that it behaved like  
... source of the rays, inas-  
... the outlines of the shadows,  
... instead of being sharp and clear as  
... when the half-dollar piece was re-  
... moved, were dimmed. It was im-  
... material for the chief object of the  
... inquiry to decide by more exact  
... methods whether the cathodic par-  
... ticles actually penetrated the window,  
... or whether a new and separate stream  
... was projected from the outer side of  
... the window. In my mind there  
... exists not the least doubt that the  
... former was the case, as in this respect  
... I have been able to obtain numerous  
... additional proofs, upon which I may  
... dwell in the near future.



AN EXPERIMENTAL SOURCE OF THE

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since observed.

I next endeavored to ascertain whether it was necessary that the obstacle outside was, as in this case, a solid body, or a liquid, or broadly, a body of measurable dimensions, and it was in investigating in this direction that I came upon the important result to which I referred in the introductory statements of this communication. I namely observed rather accidentally, although I was following up a systematic inquiry, what is illustrated in diagram Fig. 1. The diagram shows a Lenard tube of



$c$  and the straight line  $W$  were, of course, at once recognized as the outlines of the cathode  $c$  and the bottom of the cap  $A$  respectively, although, in consequence of a confusing optical illusion, they appeared much closer together than they actually were. For instance, if the distance between  $c$  and  $o$  was five inches, these lines would appear on the screen about two inches apart, as nearly as I could judge by the eye. This illusion may be easily explained and is quite unimportant, except that it might be of some moment to physicians to keep this fact in mind when making examinations with the screen as, owing to the above effect, which is sometimes exaggerated to a degree hard to believe, a completely erroneous idea of the distance of the various parts of the object under examination might be gained, to the detriment of the surgical operation. But while the lines  $c$  and  $W$  were easily accounted for, the curved lines  $f, g, a$  were at first puzzling. Soon, however, it was ascertained that the faint line  $a$  was the shadow of the edge of the aluminum cap, the much darker line  $g$  that of the rim of the glass tube  $T$ , and  $f$  the shadow of the tinfoil ring  $r$ . These shadows on the screen  $F$  clearly showed that the agency which affected the fluorescent material was proceeding from the space outside of the bulb towards the aluminum cap, and chiefly from the region through which the primary disturbances or streams emitted from the tube through the window were passing, which observation could not be explained in a more plausible manner than by assuming that the air and dust particles outside, in the path of the projected streams, afforded an obstacle to their passage and gave rise to impacts and collisions spreading through the air in all directions, thus producing continuously new sources of the rays. It is this fact which, in his recent communication

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ED LENARD TUBE.

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glass tube T, and e the shadow of the  
tin foil ring r. These shadows on the  
screen F clearly showed that the  
agency which affected the fluorescent  
material was proceeding from the  
space outside of the bulb towards the  
aluminum cap, and chiefly from the  
region through which the primary  
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be explained in a more plausible  
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air and dust particles outside, in the  
path of the projected streams, affor-  
led an obstacle to their passage and  
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spreading through the air in all  
directions, thus producing contin-  
uously new sources of the rays. It  
is this fact which, in his recent  
communication before mentioned,  
Roentgen has brought out. So, at  
least, I have interpreted his report-  
ed statement that the rays emanate  
from the irradiated air. It now re-  
mains to be shown whether the air,  
from which carefully all foreign par-  
ticles are removed, is capable of be-  
having as an impact body and source  
of the rays, in order to decide whether  
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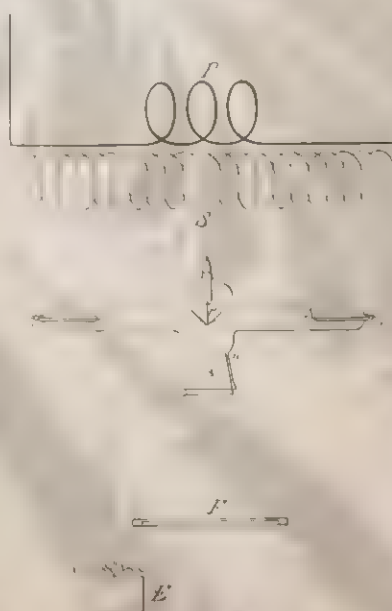


FIG. 3.—ILLUSTRATING ARRANGEMENT WITH IMPROVED DOLBIN FOCUS TUBE FOR REDUCING THE INJURIOUS ACTIONS

improved design, consisting of a tube  
T of thick glass tapering towards the  
open end, or neck n, into which is  
fitted an aluminum cap A, and a  
spherical cathode c, supported on a  
glass stem s, and platinum wire w  
sealed in the opposite end of the tube  
as usual. The aluminum cap A, as will  
be observed, is not in actual contact  
with the ground glass wall, being  
held at a small distance from the  
latter by a narrow and continuous  
ring of tin foil r. The outer space  
between the glass and the cap A  
is filled with cement c, in a manner  
which I shall later describe. F is a  
Roentgen screen such as is ordinarily  
used in making the observations.

Now, in looking upon the screen in  
the direction from F to T, the dark  
lines indicated on the lower part of  
the diagram were seen on the illu-  
minated background. The curved line

lower, it was ascertained that the  
faint line c was the shadow of the  
edge of the aluminum cap, the much  
darker line d that of the rim of the  
glass tube T, and e the shadow of the  
tin foil ring r. These shadows on the  
screen F clearly showed that the  
agency which affected the fluorescent  
material was proceeding from the  
space outside of the bulb towards the  
aluminum cap, and chiefly from the  
region through which the primary  
disturbances or streams emitted from  
the tube through the window were  
passing, which observation could not  
be explained in a more plausible  
manner than by assuming that the  
air and dust particles outside, in the  
path of the projected streams, affor-  
led an obstacle to their passage and  
gave rise to impacts and collisions  
spreading through the air in all  
directions, thus producing contin-  
uously new sources of the rays. It  
is this fact which, in his recent  
communication before mentioned,  
Roentgen has brought out. So, at  
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ed statement that the rays emanate  
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ticles are removed, is capable of be-  
having as an impact body and source  
of the rays, in order to decide whether  
the generation of the latter is depen-  
dent on the presence in

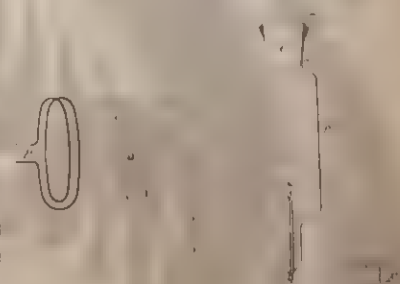


FIG. 4.—ILLUSTRATING ARRANGEMENT WITH A LENARD TUBE FOR SAFE WORKING AT CLOSE RANGE

the air of impact particles of meas-  
urable dimensions. I have reasons to  
think so.

With the knowledge of this fact we  
are now able to form a more general

(Continued on page 6)



TESLA ON THE SOURCE OF ROENTGEN RAYS AND THE PRACTICAL CONSTRUCTION AND SAFE OPERATION OF LUMINOUS TUBE:

TO THE HON. RAY / DE WASH

I have for some time felt that a few indications in regard to the practical construction of Leonard tubes of improved design, a great number of which I have recently exhibited before the New York Academy of Sciences (April 6, 1897), would be useful and timely, particularly as by their proper construction and use much of the danger attending the experimentation with the rays may be avoided. The simple precautions which I have suggested in my previous communications to your esteemed journal are seemingly disregarded, and cases of injury to patients are being almost daily reported, and in view of this only, were it for no other reason, the following lines, referring to this subject, would have been written before had not again pressing and irremediable duties prevented me from doing so. A short and, I trust, most unwelcome interruption of the work which has been claiming my attention makes this now possible. However, as these opportunities are scarce, I will utilize the present to dwell in a few lines on some other matters to come later in connection with this subject, and particularly on a result of importance which I have reached some time ago by the aid of such a Leonard tube, and which, if I am correct, you find to be really in part similar to my own since it seems that practically the same experiment with your tube in Professor Richter's laboratory resulted in a communication to the Académie de Sciences of Berlin. This was published under reference to the name of his distinguished student, one of the Röntgen boys. As will be remembered, it related to a statement of his discovery, Richter, of his opinion that the rays which affect the sensitive substance mounted for the fluorescent spectrum apparatus at the hub of a circular metal rest made the outside responsible, although he maintained that the light from the fluorescent glass plates and spectra tubes could reflect the influence of them at least in the case of starting a new vacuum chamber with the same.

[illegible]

will be seen presently, it is not the only source.

Since recording the above fact my efforts were directed to finding answers to the following questions. First, is it necessary that the impact body should be within the tube? Second, is it required that the obstacle in the path of the cathodic stream should be solid or liquid? And, third, to what extent is the velocity of the stream necessary for the generation of and influence upon the character of the rays emitted?

In order to ascertain whether a body located outside of the tube and in the

FIG. 1.—ILLUSTRATING AN EXPERIMENT  
REVEALING THE REAL SOURCE OF THE  
ROENTGEN RAYS.

[illegible][illegible]

inside of the bath, and, what is more, indications were obtained, by observing the shadows, that it behaved like a second source of the rays, inasmuch as the outlines of the shadows, instead of being sharp and clear as when the half-dollar piece was removed, were dimmed. It was important for the chief object of the inquiry to decide by more exact methods whether the cathodic gas-jar status is penetrated the window, or whether a new and separate stream was projected from the outer side of the window. In my mind there exists not the least doubt that the former was the case in this respect. I have endeavored to obtain numerical and factual proofs of it, which I may leave to the near future.

I next endeavored to ascertain whether it was necessary that the elements be outside as well as inside a solid body or a liquid or fluid. A study of measure dimensions, and it was in investigating this direction that I came upon the important points which I referred to in the introductory statements of this communication. I naturally observed rather accidentally at the time I was following up a systematic inquiry what a contact and grip. F. I. The diagram shows a plan of the

FIG. 1. DISTRIBUTION OF ANIONIC MONOMERS WITH DIFFERENT DEGREE OF POLYMERIZATION IN THE FIRST STAGE OF POLYMERIZATION.

[illegible][illegible]

## A NEW FORM OF INDUCTION COIL

REPORT OF THE FORTY-NINTH ANNUAL  
MEETING OF THE AMERICAN  
SOCIETY OF LITHOGRAPHERS  
HOLDEN, MASS. JULY 20-28,  
1894. BY FRANK M. H. H. H. H.

The reduction can, presently, be lowered by the revised constitutes a new type employing the principle of "selective primaries" or "contingent primaries," which principle has been applied by me in a variety of ways.

For the object of this study and with reference to the direct action to be taken, the following potential for obtaining energy from the practical use of a geothermal system has been taken into account: the use of the water of the geothermal system as a heat source for such things as space heating, domestic water heating, and the production of plants of the geothermal bath, as well as to meet the energy consumption of the area and to improve the living conditions of the population. Therefore, in large quantities, and in the medium term, a new production of energy will be obtained, and no artificial structures will be necessary, as the energy will be available in the form of natural water, which will be used without the need for structures or connections.

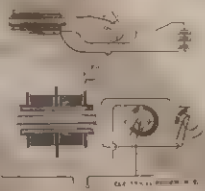
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one can find in the geological literature a number of relatively few references to the subject of the geology of the island. The only reference to the geology of the island is almost entirely devoted to the study of the island at the time of its discovery by the Portuguese, who found it to be a low-lying island with a very small area of land. The only reference to the geology of the island is almost entirely devoted to the study of the island at the time of its discovery by the Portuguese, who found it to be a low-lying island with a very small area of land.

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condenser decreases from 100 to 50 V.  
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[illegible]

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PHOTODUPLICATION OF  
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The Milwaukee Wisconsin Journal  
 for the month of January 1900  
 contains a full and complete list of the  
 names of the persons who have been  
 elected to the office of the  
 Board of the Wisconsin State  
 University, and the names of the  
 trustees of the University of the State  
 of Wisconsin, and the names of the  
 members of the Wisconsin State  
 Board of Education.

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t o p r o t e c t t h e f r a n c h i s e .

The Board of Public Works is considering a resolution of the Mayor and the Board of Public Works and the company for buying the freed way along the highway excepting the block between East and 10th streets, where they are to run on overhead, and also of the board, refusal to pay for the use of the pavement.

The Postal Telegraph Company, Portland, Me. has brought out the Inter-States Cable Company against the Postal Telegraph Company. The case arises out of the routing of the cables of the Yawm Road, a Postal Telegraph Company claiming that the cables are to be paid for at the regular rates as to the rate of nearly twice the amount of the mission of the mission.

[illegible]

## A NEW FORM OF INDUCTION COIL.

READ AT THE FOURTEENTH GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, ELIOT, ME., JULY 26-28, 1897, BY PROF. ELIHU THOMSON.

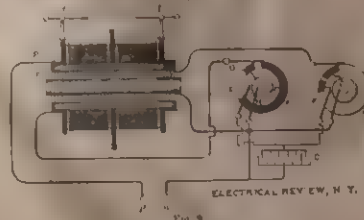
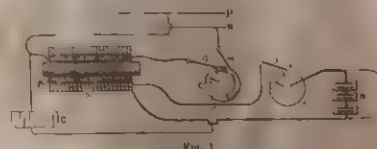
The induction coil presently to be described, it is believed, constitutes a new type employing the principle of a "substitute primary" or "secondary primary," which principle has been applied by me in a variety of ways.

The prime object of this coil is to permit the direct connection to circuits of considerable potential for obtaining energy for the production of high-potential discharges, like those of a Ruhmkorff coil for working Roentgen-ray vacuum tubes, and for such like purposes. The object, also, was to avoid the employment of banks of lamps or storage batteries, and to limit the energy consumed to only that amount required to work the coil itself. Furthermore, no larger condensers than those ordinarily used with an induction coil of equal capacity are needed, and no air-blast, while the coil as a whole is still available as an ordinary Ruhmkorff without change in its structure or connections.

To illustrate the principle, reference is made to Fig. 1, where  $p$  and  $n$  represent connections to mains at, say, 110 volts difference of potential;  $II$  is an iron wire core around which are wound two coils, one over the other, either of which may, of course, be the primary. The inner coil  $P$  in the figure is made the primary, and is wound with many turns of comparatively fine wire. For 110 volts it may have some thousands of turns and be wound with a wire safe for .5 to .75 ampere. The outside wire  $S$  may be coarse or fine. In the figure it is quite coarse and of relatively few turns,

tion with one terminal of battery  $B$  to be charged, and which touches a stationary brush  $J$ , at or about the time of the break between brush  $G$  on the main segment of  $E$ . The battery  $B$  may have terminals by which it may furnish current while being charged.

Now let the break-wheels  $E$  and  $F$  be given rapid revolution, say, 10, 20 or 30 per second. The contact of brushes  $G$  and  $H$  with the main segment of  $E$  passes current for a certain considerable fraction of the revolution, at full line potential of 110 volts, through primary  $P$ . The current rises gradually during this period, and may at the end attain a value of one ampere, more or less. With slow revolution it would be limited by the resistance of  $P$  chiefly, but at rapid rates, the time constant of  $P$  acting as a self induction, determines the ultimate value of current before breaking. Upon the break of brush  $G$  with the main segment it touches the condenser segment, which is thereby put across the break; but the circuit of  $S$  is also closed by contact of segment on  $F$  with brush  $J$ . The condenser receives only a small charge on account of the circuit of  $S$  having been closed. In fact, the break at  $G$  with main segment of  $E$  would be nearly sparkless without the condenser  $C$ , but what slight self-induction is not wiped out by the mutual induction of the currents in  $S$  and  $P$  is very easily taken care of.



PROF. ELIHU THOMSON'S NEW FORM OF INDUCTION COIL

The magnetizing of the core  $II$  or absorption of energy is by  $P$ , while delivery of energy is by  $S$ , acting as if

secondary circuit, useful as a part itself, and having turns adds a considerable total potential. The secondary is fine wire of many well insulated turns.

In Fig. 2 the marked  $S$ ,  $P$ , and coil  $P$ ,  $S$ , while marked  $S$ . The coils  $S$  and  $P$  are primaries and secondaries and primary. This is, in fact, an of  $S$ ,  $P$ , but is coil  $P$ ,  $S$ , having been secondary circuit are at 110. The break like those of Fig. there is a much st and a condenser as in  $E$ . There is circuit of  $S$ ,  $P$ , but short-circuit at time  $P$ ,  $S$  is broken current from line volts, or more. Circuit at brush  $G$  so to speak, are short circuit of  $S$ ,  $P$ , closed. The consequence breaks no spark of  $G$ ,  $E$ . As so has been fully es short circuit, and got entirely away connections on  $E$  of  $F$  breaks the circuit is conveying a very low potential. The put instantly no the spark flies be In this way a coil inch Ruhmkorff six-inch sparks, current from a 110 one-half an ampere or clock work in the break-wheels made of fair diameter in operation are only to be ob portioning of the done, and with result to be obtain

The discharge able from those korrff. In fact might be used denser  $C$  as an

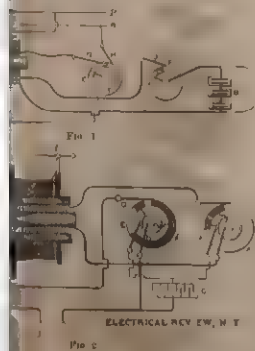




## ELECTRICAL REVIEW

one terminal of battery B is grounded, and which touches a brush J, at or about the point of break between brush G and main segment of E. The brush J may have terminals by which it may furnish current while grounded.

The break-wheels E and F make one rapid revolution, say, 10, 20 or 30 per second. The contact of brush G with the main segment of E passes current for a certain fraction of the revolution, the line potential of 110 volts of primary P. The current gradually during this period, at the end attain a value of 10, more or less. With slow motion it would be limited by the resistance of P chiefly, but at rapid motion constant of P acting as self-induction, determines the value of current passing. Upon the break of contact with the main segment of E, the condenser segment, which is cut across the break; but of S is also closed by contact on F with brush J. The user receives only a small amount of the current of S is closed. In fact, the break of main segment of E would be sparkless without the contact what slight self-induction wiped out by the mutual induction of the currents in S and P is taken care of.



THOMSON'S NEW FORM OF INDUCTION COIL.

Setting of the core I or of energy is by P, while energy is by S, acting as if closed circuit. This case does not involve

secondary circuit. It thus becomes useful as a part of the secondary itself, and having several thousand turns adds a considerable fraction to the total potential of the secondary. The secondary is, as usual, of quite fine wire of many thousands of turns, well insulated throughout.

In Fig. 2 the coarse coil is marked S P, and the intermediate coil P S, while that outside is marked S. The functions of the coils S P and P S are to act as secondaries and primaries alternately. This is, in fact, an essential function of S P, but is only incidental to coil P S, having been connected into the secondary circuit S, whose terminals are at *t t*. The break-wheels E F are like those of Fig. 1, except that in F there is a much shorter main segment and a condenser segment following, as in E. There is no battery in the circuit of S P, but it is put on dead short-circuit at intervals, just at the time P S is broken. Coil P S receives current from line at *p n*, at 100 to 200 volts, or more. On the break of this circuit at brush G the ampere turns, so to speak, are shifted suddenly into circuit of S P, closed on itself by J F. The consequence is that even at slow breaks no spark occurs at the rupture of G E. As soon as the current has been fully established in S P on short circuit, and after brush Q has got entirely away from all metallic connections on E, the main segment of F breaks the circuit of S P, which is conveying a very heavy current at low potential. The condenser C is put instantly across the break, and the spark flies between terminals *t t*. In this way a coil of the size of a six-inch Ruhmkorff gives a torrent of six-inch sparks, with an average current from a 110-volt line of about one-half an ampere. A simple motor or clock-work may be used to drive the break-wheels E F, which are made of fair diameter to insure accuracy in operation. The best results are only to be obtained when the proportioning of the parts is carefully done, and with a knowledge of the result to be obtained.

The discharges are indistinguishable from those of a similar Ruhmkorff. In fact, the coil described might be used with the same condenser C as an ordinary Ruhmkorff coil energized by batteries. In this case the terminals of the coil

## ELECTRIC RAILWAY NOTES.

McKinzie, Phil A. W. has levied an attachment on the stock of the Citizens' Traction Company, of San Diego, Cal., owned by G. B. Kerper and C. W. Foote, to secure payment of an alleged debt of \$607.20.

A trust mortgage for \$552,000 from the Falls Road Electric Railway Company, of Baltimore, to the Maryland Trust Company, to secure the issue of an equal amount of bonds, has been recorded. The bonds will run for 50 years and will bear five per cent interest.

The Milwaukee, Wis., Electric Railway and Light Company has completed negotiations for the purchase of the property of the Waukesha Beach Electric Railway Company, consisting principally of the tracks, right of way, etc., from Waukesha to Pewaukee Lake.

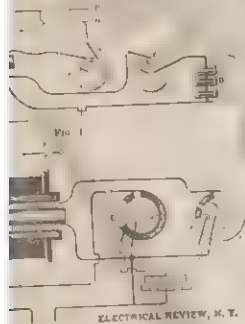
The Waukesha, Wis., Electric Railway Company, Statley I. Henderson, stockholder, has petitioned for the appointment of a receiver to wind up the affairs of the company, which was capitalized at \$3,000,000. The company was incorporated a year ago, but only enough of the road was built to protect the franchise.

The Board of Public Works is considering a proposition of the Milwaukee, Wis., Electric Railway and Light Company for burying its feed wires along Grand avenue, except along the block between Tenth and Eleventh streets, where they are to remain overhead, because of the board's refusal to tear up the asphalt pavement.

The Postal Telegraph Company, of Portland, Me., has brought suit in the United States Circuit Court against the Portland & Yarmouth Railroad Company. The case arises out of the setting of the trolley poles of the Yarmouth road, the Postal



er receives only a small amount of the circuit of S closed. In fact, the break in segment of E would workless without the contact what slight self-inducted out by the mutual the currents in S and P taken care of.



THOMSON'S NEW FORM OF INDUCTION COIL.

energizing of the core I or of energy is by P, while energy is by S, acting as if closed circuit. This converter, does not involve of energy if the ohmic of the circuit of S be low here, then, is a transfer of in one circuit to another currents are direct currents out. To insure this being S, the time of contact of F with brush J must be as not to permit any re-., the break of said segment ist be timed to be made on on of the first impulse or from S. To do this an responding to direct cur-; placed in the battery cir- the leads from S, will indi- timum direct current when out F is of proper extent, nder other conditions.

he principles of the above in mind it is easy to under- action of my new form of coil, which may be de- brieely, as follows: The I, Fig. 2, of the induction und with the ordinary coarse coil and terminals provided Then a coil of interme- ge, between the inner pri- d the outer secondary, is It is to be capable of being d across a circuit of 110 with coil P, Fig. 1. This the true primary or energy g coil, but for convenience ng of wire I prefer to connect the under portion of the real

The consequence is that even as breaks no spark occurs at the rupture of G E. As soon as the current of G E has been fully established in S P on has short circuit, and after brush Q has got entirely away from all metallic connections on E, the main segment of F breaks the circuit of S P, which is conveying a very heavy current at low potential. The condenser C is put instantly across the break, and the spark flies between terminals t t. In this way a coil of the size of a six-inch Ruhmkorff gives a torrent of six-inch sparks, with an average current from a 110-volt line of about one-half an ampere. A simple motor or clock-work may be used to drive the break-wheels E F, which are made of fair diameter to insure accuracy in operation. The best results are only to be obtained when the proportioning of the parts is carefully done, and with a knowledge of the result to be obtained.

The discharges are indistinguishable from those of a similar Ruhmkorff. In fact, the coil described might be used with the same condenser C as an ordinary Ruhmkorff coil energized by batteries. In this case the terminals of the coil section P S are disconnected, brush J lifted and battery inserted between brush G and terminal of S P, which goes to J in Fig. 2. The break-wheel E or F, when run with low potentials, may be immersed in water in the usual way to facilitate sharp breaks, but the apparatus has been very successfully run, at full output, dry, or a little heavy oil on the break suffices. Also, the flux of current in S P may be made by a magnet to break its own circuit under water when the current has risen to a predetermined amount. In other words, it may be provided with the usual automatic break, damped or adjusted not to get into tremulous vibration. It will be seen from the above description that a new way of energizing an induction coil or other transforming apparatus has been embodied, and that it consists in the rapid substitution of secondary and primary functions in the coil S P.

John H. and Harry L. Lamson have commenced a suit against the Akron, Bedford & Cleveland, Ohio, Electric Railroad Company, to compel appropriation of alleged property rights. The plaintiffs say that they own 2,000 feet of land on the line of the railway, and they want money for their rights in the street, which they claim have been usurped by the railway company.

stockholder, has proposed the appointment of a receiver to wind up the affairs of the company, which was capitalized at \$3,000,000. The company was incorporated a year ago, but only enough of the road was built to protect the franchise.

The Board of Public Works is considering a proposition of the Milwaukee, Wis., Electric Railway and Light Company for burying its feed wires along Grand avenue, except along the block between Tenth and Eleventh streets, where they are to remain overhead, because of the board's refusal to tear up the asphalt pavement.

The Postal Telegraph Company, of Portland, Me., has brought suit in the United States Circuit Court against the Portland & Yarmouth Railroad Company. The case arises out of the setting of the trolley poles of the Yarmouth road, the Postal Telegraph Company claiming that the trolley wires have been placed so near to the telegraph wires as to make the latter nearly useless for the transmission of messages.

Mrs. Luther Lane has brought an odd suit against the Cleveland, Ohio, Electric Railway Company. She claims damages for two separate causes of action, but both of them involve the same state of facts, except that they occurred several years apart. The first cause arose April 18, 1894. Plaintiff charges that she was on one of the defendant's cars and wished to alight at the corner of Dunham and Lexington avenues. She says that the car was started before she could get off, and that she was thrown to the ground, injuring her arm, shoulder and hip, and suffering great nervous shock from her fall. For this she claims \$2,500. May 24, 1897, at the same corner, in one of defendant's cars, she charges that she was again thrown down in the same way, and injured the same shoulder, arm and hip. Damages in this case are laid at \$3,000. She charges that her injuries were so severe that she has not been able to attend to her duties as a housewife since.



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charge on account of the circuit of P  
having been closed. In fact, the break  
at G with main segment of E would  
be nearly sparkless without the con-  
denser C, but what slight self-induc-  
tion is not wiped out by the mutual  
induction of the currents in S and P  
is very easily taken care of.

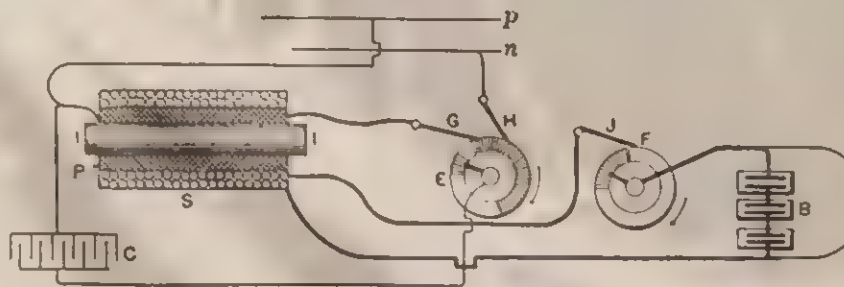


FIG. 1.

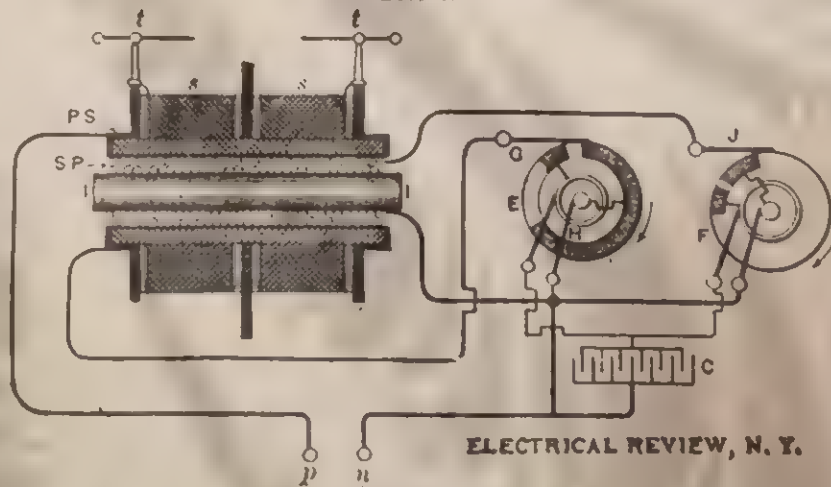


FIG. 2.

ELECTRICAL REVIEW, N. Y.

## PROF. ELIHU THOMSON'S NEW FORM OF INDUCTION COIL.

The magnetizing of the core II or  
absorption of energy is by P, while  
delivery of energy is by S, acting as if  
nearly on a closed circuit. This con-

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August 11, 1897

## TESLA ON ROENTGEN RAYS.

(Concluded from page 67.)

idea of the process of generation of the radiations which have been discovered by Lenard and Roentgen. It may be comprised in the statement that the streams of minute material particles projected from an electrode with great velocity in encountering obstacles wherever they may be, within the bulb, in the air or other medium or in the sensitive layers themselves, give rise to rays or radiations possessing many of the properties of those known as light. If this physical process of generation of these rays is undoubtedly demonstrated as true, it will have most important consequences, as it will induce physicists to again critically examine many phenomena which are presently attributed to transverse ether waves, which may lead to a radical modification of existing views and theories in regard to these phenomena, if not as to their essence so, at least, as to the mode of their production.

My effort to arrive at an answer to the third of the above questions led me to the establishment, by actual photographs, of the close relationship which exists between the Lenard and Roentgen rays. The photographs bearing on this point were exhibited at a meeting of the New York Academy of Sciences—before referred to—April 6, 1897, but, unfortunately, owing to the shortness of my address, and concentration of thought on other matters, I omitted what was most important; namely, to describe the manner in which these photographs were obtained, an oversight which I was able to only partially repair the day following. I did, however, on that occasion illustrate and describe experiments, in which was shown the deflectibility of the Roentgen rays by a magnet, which establishes a still closer relationship, if not identity, of the rays named

## ELECTRICAL RE

described, in which the primary is operated by the discharge of a condenser. With such an instrument any desired suddenness of the impulses may be secured, there being practically no limit in this respect, as the energy accumulated in the condenser is the most violently explosive agent we know, and any potential or electrical pressure is obtainable. Indeed, I found that in increasing the suddenness of the electro motive impulses through the tube—without, however, increasing, but rather diminishing the total energy conveyed to it—phosphorescence was observed and rays began to appear, first the feebler Lenard rays and later, by pushing the suddenness far enough, Roentgen rays of great intensity, which enabled me to obtain photographs showing the finest texture of the bones. Still, the same tube, when again operated with the ordinary coil of a low rate of change in the primary current, emitted practically no rays, even when, as before stated, much more energy, as judged from the heating, was passed through it. This experience, together with the fact that I have succeeded in producing by the use of immense electrical pressures, obtainable with certain apparatus designed for this express purpose, some impressions in free air, have led me to the conclusion that in lightning discharges Lenard and Roentgen rays must be generated at ordinary atmospheric pressure.

At this juncture I realize, by a perusal of the preceding lines, that my scientific interest has dominated the practical, and that the following remarks must be devoted to the primary object of this communication—that is, to giving some data for the construction to those engaged in the manufacture of the tubes and, perhaps, a few useful hints to practicing physicians who are dependent on such information. The foregoing was, nevertheless, not lost for this object, inasmuch as it has shown how much the result obtained depends on the proper construction of the instruments, for, with ordinary implements, most of the above observations could

outside, experienced is practical a high vacuum side cap. able to is by cooling air, for in following this the tube through the pressure, and brought condition. permanent through the reduced at that no greater result aluminum are not observed immediately of the inner and metal.

With tubes described, it is observed this is taken in inserting the down as low without end it is then got of the tube, straight.

The two in the manufacture are, however, the aluminum ring in of the latter may be even one-sixth and in such may be thin sink tool about in diameter without tearing further than done by hand and, finally, gently beaten close the pores slow leak. In this way I have a hole in the closed with a few thousand riveted to the washer of the



to their essence so, at least, as to the mode of their production.

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To bring out clearly the significance of the photographs in question, I would recall that, in some of my previous contributions to scientific societies, I have endeavored to dispel a popular opinion before existing that the phenomena known as those of Crookes were dependent on and indicative of high vacuum. With this object in view, I showed that phosphorescence and most of the phenomena in Crookes bulbs were producible at greater pressures of the gases in the bulbs by the use of much higher or more sudden electro-motive impulses. Having this well demonstrated fact before me, I prepared a tube in the manner described by Lenard in his first classical communication on this subject. The tube was exhausted to a moderate degree, either by chance or of necessity, and it was found that, when operated by an ordinary high tension coil of a low rate of change in the current, no rays of any of the two kinds could be detected, even when the tube was so highly strained as to become very hot in a few moments. Now, I expected that, if the suddenness of the impulses through the bulb were sufficiently increased, rays would be emitted. To test this I employed a coil of a type which I have repeatedly

used. This experience, together with the fact that I have succeeded in producing by the use of immense electric pressure, obtainable with certain apparatus, as high as 100,000 volts, free air, have led me to the conclusion that in high tension coils, Lenard and Roentgen rays are generated at a very low electric pressure.

At this juncture I must, by permission of the president, beg pardon from the scientific interest has found the practical, and that the following remarks must be devoted to the primary object of this communication—namely, to giving some data for the construction to those engaged in the manufacture of the tubes and, perhaps, a few useful hints to practicing physicists who are dependent on such information. The foregoing was, nevertheless, not lost for this object, inasmuch as it has shown how much the result obtained depends on the proper construction of the instruments, for, with ordinary implements, most of the above observations could not have been made.

I have already described the form of tube illustrated in Fig. 1, and in Fig. 2 another still further improved design is shown. In this case the aluminum cap A, instead of having a straight bottom as before, is shaped spherically, the center of the sphere coinciding with that of the electrode *e*, which itself, as in Fig. 1, has its focus in the center of the window of cap A, as indicated by the dotted lines. The aluminum cap A has a tinfoil ring *r*, as that in Fig. 1, or else the metal of the cap is spun out on that place so as to afford a bearing of small surface between the metal and the glass. This is an important practical detail as, by making the bearing surface small, the pressure per unit of area is increased and a more perfect joint made. The ring *r* should be first spun out and then ground to fit the neck of the bulb. If a tinfoil ring is used instead, it may be cut out of one of the ordinary tinfoil caps obtainable in the market, care being taken that the ring is very smooth.

In Fig. 3 I have shown a modified design of tube which, as the two types before described, was comprised in the collection I exhibited. This, as will be observed, is a double-focus tube, with impact plates of iridium alloy and an aluminum cap A opposite the same. The tube is not shown because of any originality in design, but simply to illustrate a practical feature. It will be noted that the aluminum caps in the tubes described are fitted inside of the necks and not

outside. This precaution if properly taken in their preparation inserting the cap the latter down as low as it is deemed without endangering the glass is then gently pushed in of the tube, taking care that it is straight.

The two most important points in the manufacture of such are, however, the thinning the aluminum window and ing in of the cap. The metal latter may be one thirty-eighth or one-sixteenth of an inch and in such case the center may be thinned down by a sink tool about one-fourth of an inch in diameter as far as it is without tearing the sheet. Further thinning down may be done by hand with a screw and, finally, the metal gently beaten down so as to close the pores which might slow leak. Instead of proceeding this way I have employed a hole in the center, which closed with a sheet of paper a few thousandths of an inch riveted to the cap by a washer of thick metal, but were not quite as satisfactory.

In sealing the cap I have the following procedure. I fastened on the pump in position and exhausted to permanent conditions a great degree of exhaustion as a perfection of the joint. The usual consideration, but the serious defect as might be felt is now gradually applied by means of a gas stove temperature up to about 1 point of sealing wax is used space between the cap and is then filled with sealing wax, quality and when the last to boil, the temperature is allowed to settle in the cavity heat is then again increased process of heating and repeated several times until cavity, upon reduction of the state, is found to be filled with the wax, all bubbles have appeared. A little more wax put on the top and the carried on for an hour or more to the capacity of the application of moderate heat below the melting point of

A tube prepared in this way will maintain the vacuum and will last indefinitely used for a few months, it usually lose the high vacuum can be quickly worked over, if after long use it is necessary to clean the tube easily done by gently war taking off the cap. It

described, in which the primary is operated by the discharges of a condenser. With such an instrument any desired suddenness of the impulses may be secured, there being practically no limit in this respect, as the energy accumulated in the condenser is the most violently explosive agent we know, and any potential or electrical pressure is obtainable. Indeed, I found that in increasing the suddenness of the electro motive impulses through the tube—without, however, increasing, but rather diminishing the total energy conveyed to it—phosphorescence was observed and rays began to appear, first the feeblest Lenard rays and later, by pushing the suddenness far enough, Roentgen rays of great intensity, which enabled me to obtain photographs showing the finest texture of the bones. Still, the same tube, when again operated with the ordinary coil of a low rate of change in the primary current, emitted practically no rays, even when, as before stated, much more energy, as judged from the heating, was passed through it. This experience, together with the fact that I have succeeded in producing by the use of immense electrical pressures, obtainable with certain apparatus designed for this express purpose, some impressions in free air, have led me to the conclusion that in lightning discharges Lenard and Roentgen rays must be generated at ordinary atmospheric pressure.

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ter, as is frequently done. Long experience has demonstrated that it is practically impossible to maintain a high vacuum in a tube with an outside cap. The only way I have been able to do this in a fair measure is by cooling the cap by a jet of air, for instance, and observing the following precautions. The air jet is first turned on slightly and upon this the tube is excited. The current through the latter, and also the air pressure, are then gradually increased and brought to the normal working condition. Upon completing the experiment the air pressure and current through the tube are both gradually reduced and both so manipulated that no great differences in temperature result between the glass and aluminum cap. If these precautions are not observed the vacuum will be immediately impaired in consequence of the uneven expansion of the glass and metal.

With tubes, as these presently described, it is quite unnecessary to observe this precaution if proper care is taken in their preparation. In inserting the cap the latter is cooled down as low as it is deemed advisable without endangering the glass and it is then gently pushed in, the neck of the tube, taking care that it sets straight.

The two most important operations in the manufacture of such a tube are, however, the thinning down of the aluminum window and the sealing in of the cap. The metal of the latter may be one thirty-second or even one-sixteenth of an inch thick, and in such case the central portion may be thinned down by a countersink tool about one fourth of an inch in diameter as far as it is possible without tearing the sheet. The further thinning down may then be done by hand with a scraping tool; and, finally, the metal should be gently beaten down so as to surely close the pores which might permit a slow leak. Instead of proceeding in this way I have employed a cap with a hole in the center, which I have closed with a sheet of pure aluminum a few thousandths of an inch thick, riveted to the cap by means of a washer of thick metal, but the results were not quite as satisfactory.

In sealing the cap I have adopted the following procedure. The tube is fastened on the pump in the proper position and exhausted until a permanent condition is reached. The degree of exhaustion is a measure of perfection of the joint. The leak is usually considerable, but this is not so serious a defect as might be thought,

may be done first with acid, then with highly diluted alkali, next with distilled water, and finally with pure rectified alcohol.

These tubes, when properly prepared, give impressions much sharper and reveal much more detail than those of ordinary make. It is important for the clearness of the impressions that the electrode should be properly shaped, and that the focus should be exactly in the center of the cap or slightly inside. In fitting in the cap, the distance from the electrode should be measured as exactly as possible. It should also be remarked that the thinner the window, the sharper are the impressions, but it is not advisable to make it too thin, as it is apt to melt in a point on turning on the current.

The above advantages are not the only ones which these tubes offer. They are also better adapted for purposes of examination by surgeons, particularly if used in the peculiar manner illustrated in diagrams Fig. 3 and Fig. 4, which are self-explanatory. It will be seen that in each of these the cap is connected to the ground. This decidedly diminishes the injurious action and enables also to take impressions with very short exposures of a few seconds only at close range, inasmuch as, during the operation of the bulb, one can easily touch the cap without any inconvenience, owing to the ground connection. The arrangement shown in Fig. 4 is particularly advantageous with a form of single terminal, which coil I have described on other occasions and which is diagrammatically illustrated, P being the primary and S the secondary. In this instance the high-potential terminal is connected to the electrode, while the cap is grounded. The tube may be placed in the position indicated in the drawing, under the operating table and quite close, or even in contact with the body of the patient, if the impression requires only a few seconds as, for instance, in examining parts of the members. I have taken many impressions with such tubes and have observed no injurious action, but I would advise not to expose for longer than two or three minutes at very short distances. In this respect the experimenter should bear in mind what I have stated in previous communications. At all events it is certain that, in proceeding in the manner described, additional safety is obtained and the process of taking impressions much quickened. To cool the cap, a jet of air may be used, as before stated, or the cap may be



when again operated with the ordinary coil of a vacuum tube, the same tube, immediately impaired in consequence of the vacuum being lost. The vacuum is maintained in the tube by the use of a special apparatus, as before described, which is used in connection with the tube. The tube is then placed in the apparatus, and the vacuum is maintained by the use of the apparatus. The apparatus is designed for this express purpose, some impressions in free air, have led me to the conclusion that in lightning discharges, Lenzel and Lenzel rays must be generated at ordinary atmospheric pressure.

At this juncture I realize, by a perusal of the preceding lines, that my scientific interest has dominated the practical, and that the following remarks must be devoted to the primary object of this communication—that is, to giving some data for the construction of those engaged in the manufacture of the tubes and, perhaps, a few useful hints to practicing physicians who are dependent on such information. The foregoing was nevertheless, not lost for this object, inasmuch as it has shown, how much the result obtained depends on the proper construction of the instrument, for, with ordinary implements, most of the above observations could not have been made.

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In sealing the cap I have adopted the following procedure. The tube is fastened on the pump in the proper position and exhausted until a permanent condition is reached. The degree of exhaustion is a measure of perfection of the joint. The leak is usually considerable, but this is not serious as far as might be thought. Heat is now gradually applied to the tube by means of a gas stove until a temperature up to about the boiling point of sealing wax is reached. The space between the cap and the glass is then filled with sealing wax of good quality, and when the latter begins to boil, the temperature is reduced to allow its setting in the cavity. The heat is then again increased, and this process of heating and cooling is repeated several times until the entire cavity, upon reduction of the temperature, is found to be filled uniformly with the wax, all bubbles having disappeared. A little more wax is then put on the top and the exhaustion, carried on for an hour or so, according to the capacity of the pump, by application of moderate heat much below the melting point of the wax.

A tube prepared in this manner will maintain the vacuum very well, and will last indefinitely. If it is used for a few months, it may gradually lose the high vacuum, but it can be quickly worked up. However, if after long use it becomes necessary to clean the tube, this is easily done by gently warming it and taking off the cap. The cleaning

The above advantages are not the only ones which these tubes offer. The vacuum heater adapted for percutaneous examination by a syringe, put in use in the hospital at New York, and in the hospital at New York, is a self-explanatory device. It is a small tube of glass, the apex of which is attached to the ground. The electrode is attached to the inner end of the tube, and the other end of the tube is attached to the ground. The tube is then placed in the apparatus, and the vacuum is maintained by the use of the apparatus. The apparatus is designed for this express purpose, some impressions in free air, have led me to the conclusion that in lightning discharges, Lenzel and Lenzel rays must be generated at ordinary atmospheric pressure.

NICK LA TEMA.

New York, August 7.

#### Electric Light Plant Wanted.

Mr. T. J. Lillard, treasurer of the Elkin Manufacturing Company, of Elkin, Surry County, N. C., manufacturer of cotton yarns, twines, etc., writes to the *Electric Review*, under date of August 7, as follows:—We want prices and estimates on a 10-light incandescent dynamo, with board, wire and everything used, to light the town of Elkin with, say 100 single-power street lights, and for 50 stores and residences with a gas light each.



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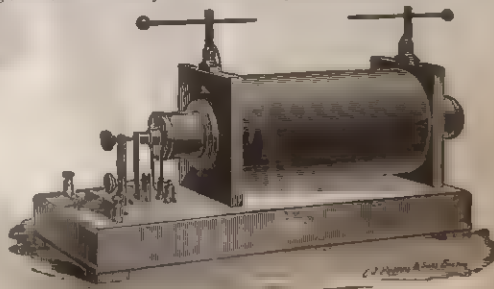
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- 587,421 Electric arc lamp; S. Bergmann, New York, N. Y.
- 587,433 Electric signaling system; M. De Brouwer, Washington, D. C.
- 587,445 Automatic telephone system; M. Froment, Paris, France.
- 587,446 Electrotherapeutic apparatus; E. Geiger, Philadelphia, Pa.—A main circuit, a patient or operator circuit; a fixed resistance in series with the operator circuit, and a variable resistance in the main circuit, all in shunt with the patient or operator circuit.
- 587,437 Apparatus for manufacturing articles of metal; J. L. Koss, Pitt River, Liverpool, England—A cathode consisting of a metallic vessel having a porous protective lining.
- 587,441 Regulating apparatus for electrically driven machinery; W. H. Knight, Newton, Mass.
- 587,442 Method of regulating electrically driven machinery; W. H. Knight, Newton, Mass.
- 587,438 Electric switch; H. W. Smith, Pittsfield, Mass.—Compress a block, a plug undercut recess therein, a contact plate bent to correspond substantially with said recess, and a pin within said recess to secure said plate in place.
- 587,463 Electric arc lamp; E. F. Taylor, West Chester, Pa.
- 587,467 Telephone central station signaling circuit; G. K. Thompson, Boston, Mass.
- 587,469 Battery office switchboard system; W. S. Harrison, Chicago, Ill.
- 587,477 Electric signal device for elevators; Rastke, St. Louis, Mo.
- 587,478 Electric motor or dynamo electromotor; R. Lindell, Brooklyn, N. Y.—The motor having a rotor armature and a stator core composed of separate laminations, the parts being arranged so that magnetic poles surrounded by an energizing coil are placed at right angles to the axis of the armature, producing a torque imparted without disturbance to the machine.
- 587,534 Electric alarm for cars; A. Nauman, New York, N. Y.
- 587,535 Electric signal box; A. T. Whitbeck, Cleveland, Ohio.
- 587,508 Electric heating apparatus; O. D. Brown, Mass.—Consists of a tank containing water, connected to a boiler with the contents of the tank will be heated to a temperature above boiling point, and used as a source of heat for adjacent rooms or buildings.
- 587,576 Dynamo-electric machine; C. M. Gross, Cleveland, Ohio—Consists of a series of rotating coils of armature wires connected with commutator segments at one end, and with brushes at the other, the brushes being local and vertical, and connected by brushes to engage the commutator rings.
- 587,591 Electric plowing wheel; H. Lynde, New York, N. Y.
- 587,592 Electric control; A. I. McMahon, Dayton, Ohio—A metallic cover plate, having perforations in various proportions, each side of the plate covered with wire cloth secured in said perforation, but removed from said plate edges.
- 587,614 Electric wire lock; C. J. Strain, Birmingham, Ala.
- 587,615 Electric signal box; W. M. Schuchman, Pa.—Comprises a vessel provided with a contact carrying armature, a spring mechanism, no second contact armature and a fixing portion of the mechanism.
- 587,649 Electric chair; E. F. Davis, West Garden, N. Y.—A chair having means for passing through the current through a person seated therein, a foot rest, a seat

## Tesla's System of Energy Transmission to a Distance Without Wires.

In view of the many reports which are appearing in the sensational dailies about Tesla's work, it appears only justice to this earnest and modest worker that we should publish the following sensible statement reported in such a competent and carefully edited journal as the *Star*, of this city. The statement is reported as follows in its even-numbered issue of August 4

Nikola Tesla this morning denied the report that he had announced the completion of his discovery of a method of telegraphy without wires. His reports of the progress of the work had been published from time to time, he said. His experiments had been repeatedly shown in strict confidence to some of his personal friends, but the publication of them in any detail must have been a violation of confidence. As a matter of fact, no experiments were made at the laboratory yesterday. The inventor, however, was willing to give some account of his work up to the present time.

“In a paper delivered about four years ago,” he said, “before the National Electric Light Association in London, that was in March, 1893, I explained a certain way for producing electrical energy from the object of transmission. I have messages and even pictures in place of letters and the use of any wires.”

“The paper in the American Association of Engineers,” said one of the gentlemen, “explained that there is a certain kind of frequency of vibration that is not perceptible, and a great light where there is a less dense and transparent body, such as the atmosphere.”

So his first apprehension was that exactly what it was that he was doing was to pump periodicity into it. It was electricity and forces that again into it. It was the earth's energy, and finally, the electricity that went in the earth, as well as in the sky. This, I think I had, as a matter of fact, conceived long before. But I had previously lacked the courage to say. And I did not believe in the world. At the time of this, I was not a scientific man. I had seen such results that I could not find enough to honour the project. I was not a scientist. Shortly afterwards, as we return, I think that I had a better idea. I had a more profound impression that was added to create a disturbance in the manner of the interference.

It is a pleasure and a commitment at the same time to be a coach from season 2 to the first year, to assist in a familiarization phase. When later, during laboratory training, and the first intervention with the trainees, the first demonstration is given, which involves a very obvious demonstration, it was no small satisfaction to me that a few of them had already done it on their own before the first demonstration was given. They were very pleased. It was also the experience that I have made in other years, because it is very important to be confident and to be able to express it, that not regular, but that they are able to learn and to improve.

It is, perhaps, the fact that we are not a result  
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The Mayor and Gas Committee will receive bids to light the City of Waco, on all night and also on a moonlight schedule, with 125 to 200 arc lights, 2,000 c. p., for a term of two to five years. We will also receive bids to install an electric light plant, specifications for which will be furnished by City Engineer on demand. All bids must be accompanied by a \$1,000 certified check. We reserve the right to reject any or all bids. The bids will be opened by the Mayor and Gas Committee at 3 p. m., October 7th, 1897.

C. C. McCulloch,  
Mayor, Waco, Texas.

ATTEST  
R. W. JORDONOWSKI,  
Clerk.

**"Dixie."** The Southern Industrial  
Lumber Co.'s the truth  
about southern co-  
mercial possibilities. If  
you are interested, write for 3 months or \$1  
per year.

**Wanted—An Idea** Who can think of a new simple thing to patent? Protect your ideas, they may bring you a wealth. Write JOHN WEDDERBURN & CO. Patent Attorneys, Washington, D. C. for the \$100,000 prize offer and list of two hundred inventions wanted.

**DYER & DRISCOLL,**  
PATENT SOLICITORS,  
31 NASSAU STREET, N. Y.

have done all my patent soliciting work, both for this and foreign countries continuously for the past fourteen years.

# PATENTS.

TRADE MARKS DESIGNS COPYRIGHTS

## CAN YOU OBTAIN A PATENT?

Send me a model or drawing of your inven-  
tion, and a description of it, and I will examine same  
and advise you promptly. My fees are moderate  
in all Patent matters, and I can obtain a Patent  
in the shortest possible time.

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Rev. J. S. Es. "Electrical Review," New York;  
Washington, D. C. Teller, L. C. National Bank,  
Judge Geo. D. Parker, Denver,  
Second National Bank Washington, D. C.  
K. Lee, U. S. Mint Philadelphia, Pa.; W. E.  
Newell, Manager and Secretary Water Works,  
Columbia, Oregon

EDW. S. DUVALL,  
Solicitor of Patents.  
Loan and Trust Bldg.  
WASHINGTON, D. C.

The Mountain Chautauqua.

[illegible]

Maintain Lane Park is located on the  
an line of the B. & O. Railroad and as  
the East train stop at the Park during  
the summer, passengers have the advantage of  
their stop in train service between the East  
and West.



Property of  
Leland Irving Anderson

# THE AMERICAN

NOVEMBER 30, 1901

NEW YORK, NOVEMBER 30, 1901

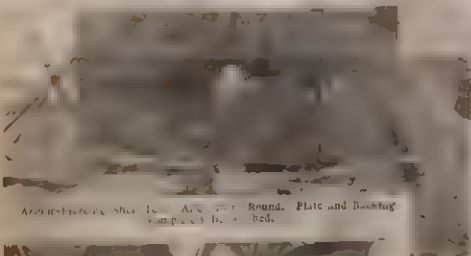
CONTENTS



Photograph of a large, dark, rectangular object, possibly a shell or a piece of equipment, lying on a light-colored surface.



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TESTS OF HIGH EXPLOSIVE SHELL AT SANDY HOOK—(See page 2)

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### Tenba's Recent Patents.

The apparatus which is employed at the receiving station consists in the combination of a storage device included in a circuit, connection points at a distance from the source of the disturbances and by which, when a difference of potential is created by the disturbances; a receiving circuit connected with the storage device; a receiver included in the receiving circuit, and a mechanism for closing the receiving circuit at any desired moment, thereby causing the receiver to be operated by the energy with which the storage device has been charged.

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positively electrified by the inv  
electricity is carried off from  
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Several patents have been granted to Walther Nernst and Marshall W. Hanks for processes designed to overcome various noticeable defects in the Nernst lamp. Mr. Hanks intends to use the process of heating of a single spiral. A single spiral sufficient to produce uniformity, but the spiral is to be distributed to every part of the lamp. In the Nernst lamp, the spiral is of a single piece of metal, and the heat is distributed to every part of the lamp.

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**ELECTRICAL MOUSE TRAP**

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demick P. Vaughan, of Perry.



**A BALL BEARING WHEEL**

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#### Burglars' Tools.

It has been said in papers  
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ated cases  
may be employed. It is absolutely desirable that the  
disturbance should be as powerful as possible and  
should be transmitted with a minimum loss. The  
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there is necessarily limited only  
an instantaneous amount of energy is thus available  
for a single use at the receiver. Furthermore,  
the energy is transmitted through the cooperation of the  
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the operation of ordinary re-  
these limitations of the two  
each reproduces arbitrarily  
disturbance or effects trans-  
through the air to a distant  
the energy derived from  
the receiving station to charge  
the accumulated potential as  
the receiver device.

which is employed in it.  
station and the inclusion of a storage de-  
vice included in a circuit connection points at a dis-  
tance from the source of the disturbances and be-  
tween which a difference of potential is created by  
such disturbances. The receiving circuit is connected to  
the storage device. The storage device is included in a  
circuit, and a mechanism for closing the circuit  
circuit at any desired moment, thereby causing  
the receiver to be operated by the energy with which  
the storage device has been charged.

In another method the energy stored is not, as in  
the preceding instance, obtained from the energy of  
the disturbances, but from an independent source. The method in gen-  
eral consists in charging a storage device with en-  
ergy from an independent source, controlling the  
charge of the device by the action of the effects or  
disturbances transmitted through the natural media,  
and subsequently using the stored energy for operat-  
ing a receiver. A condenser is used as the storage  
medium.

The invisible radiations of the spectrum and of  
vacuum tubes are generally considered to be vi-  
brations of extremely small wave length. These  
radiations possess the property of charging and dis-  
charging conductors of electricity, the discharge being  
particularly noticeable when the conductor upon  
which the rays impinge is positively electrified. It  
is usually held that these radiations ionize or render  
conducting the atmosphere through which they are  
propagated. Tesla's own experiments lead him now  
to conclusions more in accord with the theory  
he has already advanced, in which he holds that  
instead of such radiant energy throw off with great  
velocity minute particles of matter which are strongly  
electrified and therefore capable of charging an in-  
sulated conductor or, even if not so, of discharging an  
electric conductor either by carrying off electricity as  
they pass or otherwise. Tesla has taken out a patent  
based on a discovery which he has made that when  
rays of radiations of this kind are permitted to fall  
upon an insulated conducting body connected with  
one of the terminals of a condenser while the other  
terminal is made by independent means to receive  
or carry away electricity, a current flows into the  
condenser so long as the insulated body is exposed to  
the rays. Under certain conditions an indefinite ac-

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**IMPROVED FORM OF INCANDESCENT LAMP COMPARED WITH ONE TYPE**

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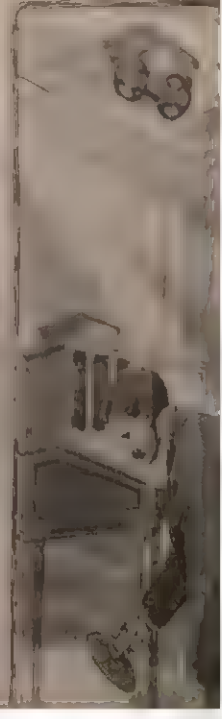
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s discharged through a suitable receiver.

**Recent Improvements in the Nernst Lamp.**  
Several patents have recently been issued in the  
States to Walther Nernst, Henry N. Potter,  
Marshall W. Hanks, for processes and devices de-  
to overcome various defects which have been  
in the Nernst lamp.  
Nernst intends to use several spirals of wire to  
the heating of a single glower, or a number of  
A single spiral suffices to heat small glowers  
sufficient uniformity, but when glowers of large  
capacity are to be started up, the heat must  
be evenly distributed to prevent cracking of the  
Instead of increasing the diameter and length  
of a small heater, which is rather costly, Mr.  
Nernst finds it cheaper to multiply heaters in parallel  
heaters equal in surface to a single large  
heater will heat up more quickly, as they  
a fraction of the mass of the large one.  
heaters can be so distributed about a glower  
that combined effects heat much more evenly  
single spiral practically can.  
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Property of  
Island Irving Anderson

# SCIENTIFIC AMERICAN

JOURNAL OF PRACTICAL INFORMATION

Vol. 46 SEPTEMBER 30, 1911



THE GREAT QUARRY OF PERKINS, SWITZERLAND





View of the building at the foot of the hill, showing the dome and the chimneys. The building is the Tesla Motor Works, Staten Island, New York.

## The Tesla Steam Turbine

The Rotating Motor, Referred to Its Simplest Form

It will interest the readers of the *Scientific American* to know that Nikola Tesla, whose reputation must naturally stand as the center of authority in electrical engineering when the art was yet in its comparative infancy, is by training and choice a mechanical engineer with a long and successful career.

His efforts to improve the efficiency of the turbine, and the result of his work, are the subject of the paper shown in the illustration. The New York Edison Company has placed the facilities of their great plant at his disposal, and the accompanying illustration shows the turbine at the works of the Edison Company.

The turbine, which determined Tesla's invention, is a simple machine, and as a vehicle of energy it can be obtained only in the form of a turbine.

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The turbine used in a pump.



A 200 horse power high pressure turbine.

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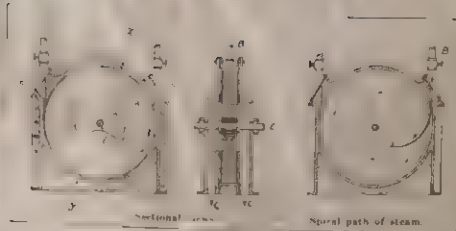
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Details of turbine

### Some Striking Coal Facts

It is a fact that the coal industry in America is one of the most important and profitable. The coal fields of the West and South are the main sources of supply for the manufacturing industries of the country. The coal industry is also one of the most important and profitable in the world.

### Foreign Students in America

The number of foreign students in America has been increasing steadily for many years. This is due to the fact that America is one of the most important and profitable countries in the world. The coal industry is also one of the most important and profitable in the world.



I think we have had of losing moved

The coal industry in America is one of the most important and profitable. The coal fields of the West and South are the main sources of supply for the manufacturing industries of the country. The coal industry is also one of the most important and profitable in the world.



The Tesla turbine testing plant at the Edison Waterworks Station, New York

## The Tesla Steam Turbine

The Rotary Heat Motor Reduced to Its Simplest Terms

I will interest the readers of the SCIENTIFIC AMERICAN in the fact that the Tesla turbine, which is now being tested at the Edison Waterworks Station, New York, is a rotary heat motor reduced to its simplest terms.

output of 200 horse-power from a single-stage steam turbine.



The Tesla turbine testing plant at the Edison Waterside Station, New York.

## The Tesla Steam Turbine

### The Rotary Heat Motor Reduced to Its Simplest Terms

It is the duty of the readers of the *Solar* to know that Nikola Tesla, whose reputation is generally based upon the contributions he made to the world of engineering when the art was yet in its comparative infancy, is by nature and training a mechanical engineer, with a strong leaning to the "rotary" of it which is covered by the term "steam engine." For several years he has devoted his attention to improving upon the rotary steam engine, and the result of his efforts and experiments is to be found in the accompanying photograph of the Tesla turbine testing plant at the Edison Waterside Station, New York.

Being on experimental work, the courtesy of the inventor, we are enabled to publish the accompanying views of the testing plant at the Waterside station, which are the first of the kind ever published.

The basic principle which determined Tesla's investigations was the well-known fact that when a fluid (such as air or water) is used as a vehicle of energy the highest possible economy can be obtained only when the changes in velocity and direction of the movement of the fluid are gradual and easy as possible. In the present form of the turbine in which the fluid is forced to move in a circular path, impact, as in the case of the piston and crank type, more or less sudden changes in direction and direction are involved, with the result that the fluid is subjected to destructive forces, such as the action of pistons, blades, etc., which are the devices of this general class, and which in a fluid involves much delicate and difficult construction which adds greatly to the cost of production and maintenance.

The desiderata in an ideal turbine, from the standpoint of the theorist, and the practical engineer, are that the turbine should be so constructed that the fluid should be so directed as to avoid the least possible losses due to friction or vacuum employed. The mechanically perfect turbine would be one which combined simplicity of construction, durability, ease and rapidity of repairs, and a small ratio of weight and space occupied.



The turbine used as a pump



output of 200 horse-power from a single-stage steam turbine with atmospheric exhaust, weighing less than 2 pounds per horse-power, which is contained within a space measuring 2 feet by 3 feet, by 2 feet in height, and which accomplishes these results with a thermal efficiency of only 130 B.T.U., that is, about one-third of the total drop available. Furthermore, considered from the mechanical standpoint, the turbine is astonishingly simple and economical in construction and by the very nature of its construction, should prove to possess such a durability and freedom from wear and breakdown as to place it, in these respects, far in advance of any type of steam or gas motor of the present day.

Briefly stated, Tesla's steam motor consists of a set of flat steel disks mounted on a shaft and rotating with a speed of the steam entering with high velocity, a series of sheets of flat disks following the steam in free spiral paths and finally exhausting the steam at their center. Instead of developing an energy of the steam by pressure reaction or impact on a series of blades or vanes, Tesla depends upon the fluid properties of adhesion and viscosity. The attraction of the steam to the faces of the disks and the cohesion of its particles to each other separates the energy of the steam from the velocity of the motion of the disks and the shaft.

By reference to the accompanying photographs and the drawings it will be seen that the turbine has a total height of 2 feet, 6 inches, and consists of 21 flat steel disks, one thousand and one hundred and one of which are made of carefully tempered steel. The turbine is assembled in a 2-foot wide or the face by the center of the disks, and when the turbine is in operation the maximum working velocity of the disks is 1,000 feet per second. The turbine is mounted on a base which is provided with two inlet pipes for use in the testing of the turbine. The turbine is a simple and direct design, and the central shaft is a simple and direct design, and the exhaust is a simple and direct design.

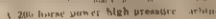
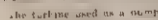
The turbine is a simple and direct design, and the central shaft is a simple and direct design, and the exhaust is a simple and direct design. The turbine is a simple and direct design, and the central shaft is a simple and direct design, and the exhaust is a simple and direct design. The turbine is a simple and direct design, and the central shaft is a simple and direct design, and the exhaust is a simple and direct design.

## The Tesla Steam Turbine

## The Tesla Steam Turbine

The Roxy Hot Man Reverts to Its Simplest Times

...the highest possible economy can be obtained in velocity and direction.


$$\begin{aligned}
 & \text{if } (x_1, x_2) \in \text{dom } f \text{ then } f(x_1, x_2) = \frac{1}{2} \left( \frac{1}{x_1} + \frac{1}{x_2} \right) \\
 & \text{else } f(x_1, x_2) = 0
 \end{aligned}$$
[illegible]

1. The first step is to identify the main topic of the document. This is often found in the title or the first few paragraphs.

2. Next, we need to determine the purpose of the document. Is it to inform, persuade, or entertain? This will help us understand the tone and style.

3. We should also look for key words or phrases that are repeated throughout the text. These can be important for understanding the main ideas.

4. Finally, we need to consider the audience. Who is the document written for? This will help us understand the level of detail and the type of language used.

The *Journal of the American Medical Association* has published a study that shows that the use of a single, low-dose, long-acting antipsychotic drug can significantly reduce the risk of hospitalization for patients with schizophrenia. The study, which was conducted by researchers at the University of California, San Francisco, found that patients who were treated with a single, low-dose, long-acting antipsychotic drug had a significantly lower risk of hospitalization than those who were treated with a combination of drugs. The study also found that patients who were treated with a single, low-dose, long-acting antipsychotic drug had a significantly lower risk of side effects than those who were treated with a combination of drugs.

1. The first part of the document is a list of names and addresses, which appears to be a directory or a list of subscribers. The names are written in a cursive script, and the addresses are listed below them.

The number of turns around the exhaust, covering in the case of the turbine, the entire circumference of the buckets, is equal to the tangent velocity of the buckets. The resistance to radial expansion is very small being the same as the centrifugal force of a ring of water of the same diameter and weight.

The buckets are of the same shape as those of the centrifugal pump, but are of a different material and are of a different shape.

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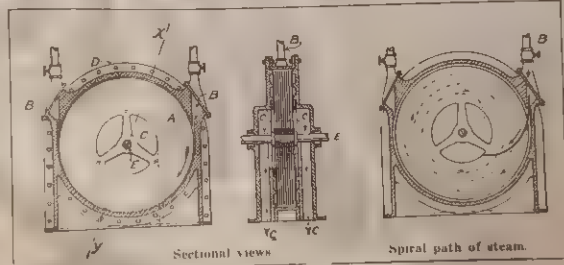
The buckets are of the same shape as those of the centrifugal pump, but are of a different material and are of a different shape.

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Details of turbine.

The buckets are of the same shape as those of the centrifugal pump, but are of a different material and are of a different shape.

Some Striking Coal Facts

Last year the United States produced 178,000,000 tons of coal, or nearly two-thirds of the world's production for the year. This is about one-third of the total production of the world, and it is about one-third of the total production of the United States.

The production of coal in the United States is about one-third of the total production of the world, and it is about one-third of the total production of the United States.

The production of coal in the United States is about one-third of the total production of the world, and it is about one-third of the total production of the United States.

The production of coal in the United States is about one-third of the total production of the world, and it is about one-third of the total production of the United States.



### Details of turbine.

$$x = \frac{1}{2} \left( \frac{1}{2} + \frac{1}{2} \right) = \frac{1}{2} \quad ; \quad y = \frac{1}{2} \left( \frac{1}{2} + \frac{1}{2} \right) = \frac{1}{2}$$

### Some Striking Coal Facts

[illegible][illegible]

## Foreign Students in America

[illegible]

... the chief of the ambassador at  
... support of the ...  
... ment Co. ... diversity ...  
... relive free of all ... charges ...

usually from the age of 14 months for the  
At 6 years to 10 years of age, the child is  
At 10 years of age, the child is  
These students are to be selected by the Jtto

A detailed black and white photograph of a large industrial machine, likely a steam engine or pump. The machine is complex, with a large flywheel visible on the right side. It features various mechanical components, including pipes, valves, and a large horizontal cylinder. The machine is mounted on a sturdy base and appears to be part of a larger industrial system.

This was the first time I had ever seen a man of color in the house of a white man.

Turbine, with upper half of casing removed.

[illegible]



The Tesla turbine testing plant at the Edison Water-side Station, New York.

## The Tesla Steam Turbine

Rotary Heat Motor Reduced to Its Simplest Terms



and free exhaust, this turbine delivers

The Tesla turbine testing plant at the Edison Waterside Station, New York.

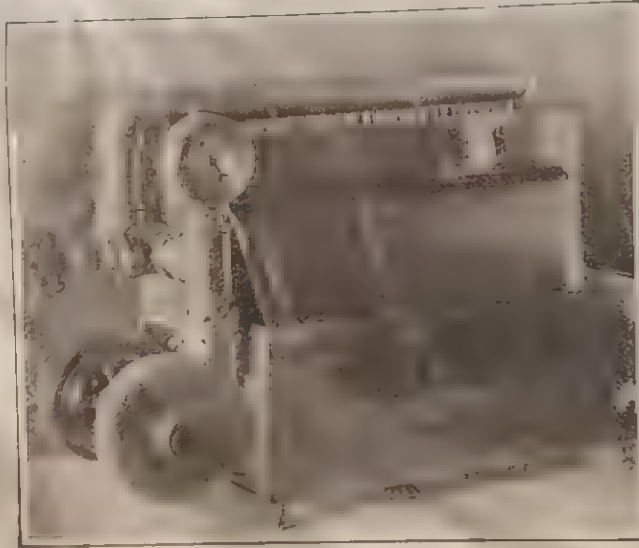
# The Tesla Steam Turbine

## The Rotary Heat Motor Reduced to Its Simplest Terms

the SCIENTIFIC AMERICAN, whose reputation for contributions he made to the art was yet in its infancy and choice a means of coming to that branch of the firm "steam engineer" has devoted much of his time to the study of thermo-dynamic theories and practical application of an entirely new form of turbine at the Waterside Company, who kindly placed the plant at his disposal.

For, we are enabled to show, representing the turbine, which are the simplest motor that have

examined Tesla's invention, let that when a fluid



This little pump, driven by a motor of  $\frac{1}{2}$  horse-power, is here shown delivering 40 gallons of water per minute against a 9 foot head.

The turbine used as a pump.

output of 200 horse power turbine with atmosphere 2 pounds per horse power a space measuring 10 feet and which accomplished a total drop available of only 130 B.T.U. the mechanical simplicity and economy of its very nature of its construction such a durable breakdown as to advance of any type in the present day.

Briefly stated. The turbine consists of a series of flat steel disks within a casing, the disks are arranged at the periphery of the casing with free spiral paths, and ports at their centers. The steam by its pressure on the series of blades or

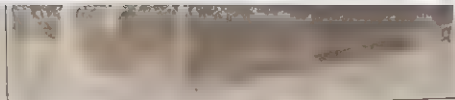
of their great plant at his disposal  
experimental work.

If the inventor, we are enabled to  
panying views, representing the  
Waterside station, which are the  
this interesting motor that have

which determined Tesla's inven-  
well-known fact that when a fluid  
is used as a vehicle of energy,  
economy can be obtained only  
in velocity and direction of the  
id are made as gradual and easy  
present forms of turbines in which  
sulted by pressure, reaction or  
De Laval, Parsons, and Curtiss  
sudden changes both of speed and  
ed, with consequent shocks, vibra-  
eddies. Furthermore, the intro-  
blades, buckets, and intercepting  
eral class, into the path of the  
delicate and difficult mechanical  
adds greatly to the cost both of  
ntenance.

an ideal turbine group themselves  
be theoretical and the mechanical  
perfect turbine would be one in  
so controlled from the inlet to the  
ergy was delivered to the driving  
possible losses due to the mechan-  
d. The mechanically perfect tur-

which combined simplicity and  
ction, durability, ease and rapidity  
all ratio of weight and space or  
delivered on the shaft. Mr Tesla  
e turbine which forms the subject  
s carried the steam and gas motor  
toward the maximum attainable  
etical and mechanical. That these  
ided is shown by the fact that in  
dison station, he is securing an



This high-pressure turbine, driven by a motor of 1/2 horse-power, is here shown  
delivering 40 gallons of water per minute against a 3-foot head.

The turbine used as a pump.



This view shows one complete high-pressure unit, with the steam  
throttle above, and below it the reversing valve and the  
turbine. Note the many gauges used in the system.  
A 200-horse-power high-pressure turbine.

Briefly stated, Tesla's steam motor consist  
of flat steel disks mounted on a shaft and  
within a casing, the steam entering with high  
at the periphery of the disks, flowing between  
free spiral paths, and finally escaping through  
ports at their center. Instead of developing  
of the steam by pressure, reaction, or im-  
series of blades or vanes, Tesla depends upon  
properties of adhesion and viscosity—the atti-  
the steam to the faces of the disks and the  
of its particles to molecular separation con-  
transmitting the velocity energy of the motion  
the plates and the shaft.

By reference to the accompanying photog-  
line drawings, it will be seen that the turb-  
rotor A which in the present case consists  
steel disks, one thirty-second of an inch in  
of hardened and carefully tempered steel,  
as assembled is 3 1/2 inches wide on the fa-  
inches in diameter, and when the turbine is  
at its maximum working velocity, the rotor  
never under a tensile stress exceeding 50,000  
per square inch. The rotor is mounted in  
D, which is provided with two inlet nozzles  
for use in running direct and B' for revers-  
ings C are cut out at the central portion of  
and these communicate directly with exha-  
formed in the side of the casing.

In operation the steam, or gas, as the cas-  
is directed on the periphery of the disks th-  
nozzle B (which may be diverging, straight  
or converging), where more or less of its expansi-  
is converted into velocity energy. When the  
is at rest the radial and tangential forces of  
pressure and velocity of the steam cause it to  
a rather short curved path toward the centra-  
opening, as indicated by the full black line  
accompanying diagram, but as the disks comm-  
otate and their speed increases, the steam  
spiral paths the length of which increases.

proportion-  
ve speed, which is at  
of the disks and is  
of the steam. Hence  
is very great, being  
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ow a baffle plate flows

mal enciencies have been obtained which demon-  
strate that in large machines based on this prin-  
ciple, in which a very small slip can be secured, the  
steam consumption will be much lower and should,  
Mr Tesla states, approximate the theoretical mini-  
mum, thus resulting in nearly frictionless tur-

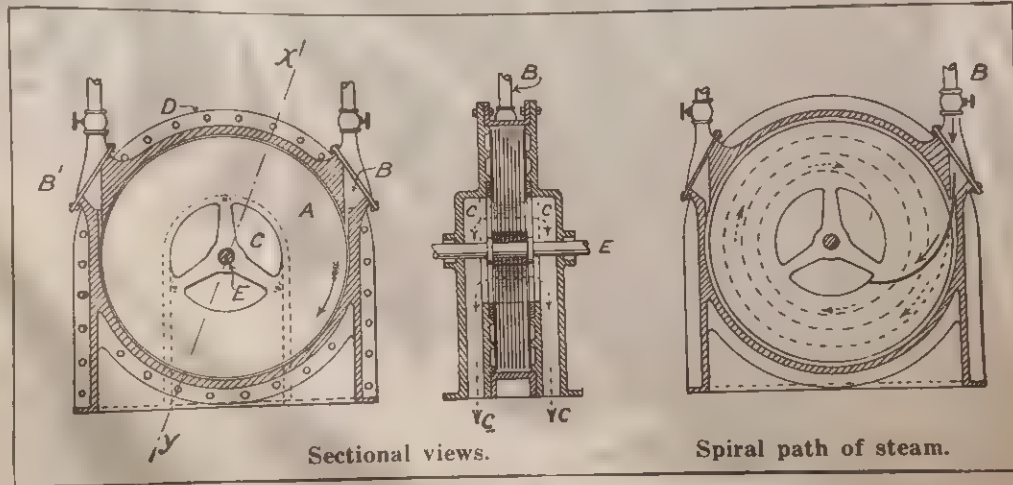
in 1900 it was 572 to  
tion of 91,972,266 the  
for each person.

Last year 725,030  
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Sectional views.

Spiral path of steam.

Details of turbine.

bine transmitting almost the entire expansive energy  
of the steam to the shaft.

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United States the  
cluding loss in m

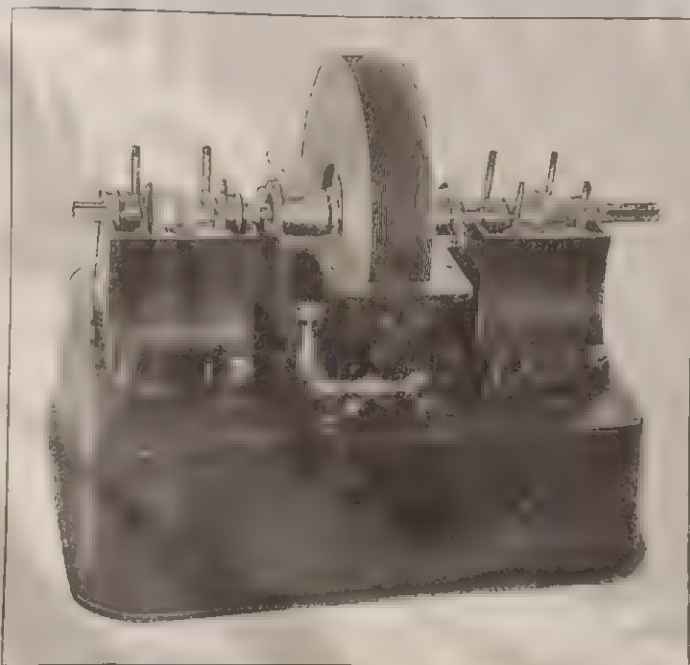
### Some Striking Coal Facts



noted that although the  
 aterside station develops  
 and at the supply  
 ld show an output  
 a full pressure of  
 Furthermore, Mr.  
 compounded and  
 low pressure unit,  
 the number of disks  
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 fording  $28\frac{1}{2}$  to 29  
 is obtained in the  
 indicate that the  
 an output of 600  
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of two identical  
 refully calibrated  
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 n is delivered to  
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 Fastened to the  
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 e pulley rotates,  
 of the same, and  
 and lenses, they  
 nd fall upon two  
 back to back on  
 bine so that the  
 gs coincides with  
 nterers are so set that

The mere increase of the coal output of the United States for 1910 over that of 1909—40,781,762 tons—was greater than the total production of any foreign



This turbine, whose rotor consists simply of a set of flat disks 18 inches in diameter, develops 200 brake horse-power on test.

**Turbine with upper half of casing removed.**

## Foreign Students

ADDRESSING the House of Representatives on many new activities of the service, Representative chairman of the House committee, recently called made by our diplomatic representatives to advertise the educational center, and been fruitful of results.

One of the outcomes of the formation in Buenos Aires of a United States University has been the means of sending Argentinians to this country. Under the auspices of the American University, given on university life is illustrated with a large stereopticon views. Negro way for an interchange of the Boston High School preparatory department La Plata. There are many Americans studying in the number is steadily

Through the efforts of Constantinople supported by Columbia University receive, free of all tuition annually from the Ottoman Empire, to pursue any of the departments. These students are to be under the supervision of the man government, with the aid of the ambassador at Constantinople.

country except Great Britain, Germany, Austria, Hun-

of the ambassador at Constantinople.

Leland Irving Anderson

# SCIENTIFIC AMERICAN

NEW YORK JUNE 4, 1904

14 CENTS A COPY  
\$3.00 A YEAR



Battleship Mikasa

Protected cruiser "Yoshino"

Torpedo boat "No. 45"



Battleship "Hasegawa" Sunk by a Min. With Loss of 450 Men  
THE JAPANESE NAVAL DISASTERS (See page 425)

# SUPPLEMENT

Scientific Am  
Scientific Am

from one town into the other. Thus  
was made. However the trade and



THE UNIVERSITY OF CHICAGO PRESS



was the shortening to 10 ft. of the 100 ft. rope. In conclusion he might say that the experiment attained such definite objects as to justify the time employed.

plate and studying its periods, and caused first at one end of the plate a high potential difference. This formed part of a plan carefully mapped out in advance. A highly sensitive self-inductance device controlling a recording instrument was included in the secondary circuit while the primary was connected to the ground and an elevated terminal of adequate

of the wire  
balls but as a

FIG. 1.—TESLA EXPERIMENTAL LABORATORY IN COLORADO, ERECTED DURING THE SUMMER OF 1900.

Designed by Mr. Tesla of the American West. In the north was made here.

ed which produced a better result than any other. (3) more round and in (4) greater area exposed a more time (5) pounds per ton for third. It was not possible to better the first one before not only the machine, but the work, in higher class, such as the (6) most laborious. Tesla, the (7) after, the (8) return to the (9) and (10) work.

#### THE TRANSMISSION OF ENERGY WITHOUT WIRES

It is a well known fact that the transmission of energy without wires is a problem of great importance. The first step in the solution of this problem is the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The second step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The third step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The fourth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The fifth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The sixth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The seventh step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The eighth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The ninth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The tenth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem.

Th variations of potential gave rise to a high potential difference. In the primary, these generated a high potential difference which in turn affected the secondary. The secondary was found to be, literally, alive with a high potential difference, and soon I was deeply interested in this interesting investigation. No better opportunity for such observations as I intended to make could be found anywhere. Colorado is a country famous for the natural displays of electric force. In that dry and rarefied atmosphere the sun's rays heat the objects

of the wire balls but as a result of the high potential difference, the secondary was found to be, literally, alive with a high potential difference, and soon I was deeply interested in this interesting investigation. No better opportunity for such observations as I intended to make could be found anywhere. Colorado is a country famous for the natural displays of electric force. In that dry and rarefied atmosphere the sun's rays heat the objects



FIG. 2.—TESLA EXPERIMENTAL LABORATORY IN COLORADO, ERECTED DURING THE SUMMER OF 1900. THE TOWER IS THE TOWER OF THE EXPERIMENT.

It is a well known fact that the transmission of energy without wires is a problem of great importance. The first step in the solution of this problem is the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The second step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The third step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The fourth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The fifth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The sixth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The seventh step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The eighth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The ninth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The tenth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem.

with these intensity of the light. The first step in the solution of this problem is the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The second step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The third step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The fourth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The fifth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The sixth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The seventh step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The eighth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The ninth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem. The tenth step was the discovery of a method of transmitting energy without the use of wires. This was accomplished by Nikola Tesla in 1891. He discovered that a high potential difference could be maintained between two points without the use of wires. This was the first step in the solution of the problem.



FIG. 1. A PERSPECTIVE VIEW OF THE CAMERA BODY WITH LENS CAP REMOVED.

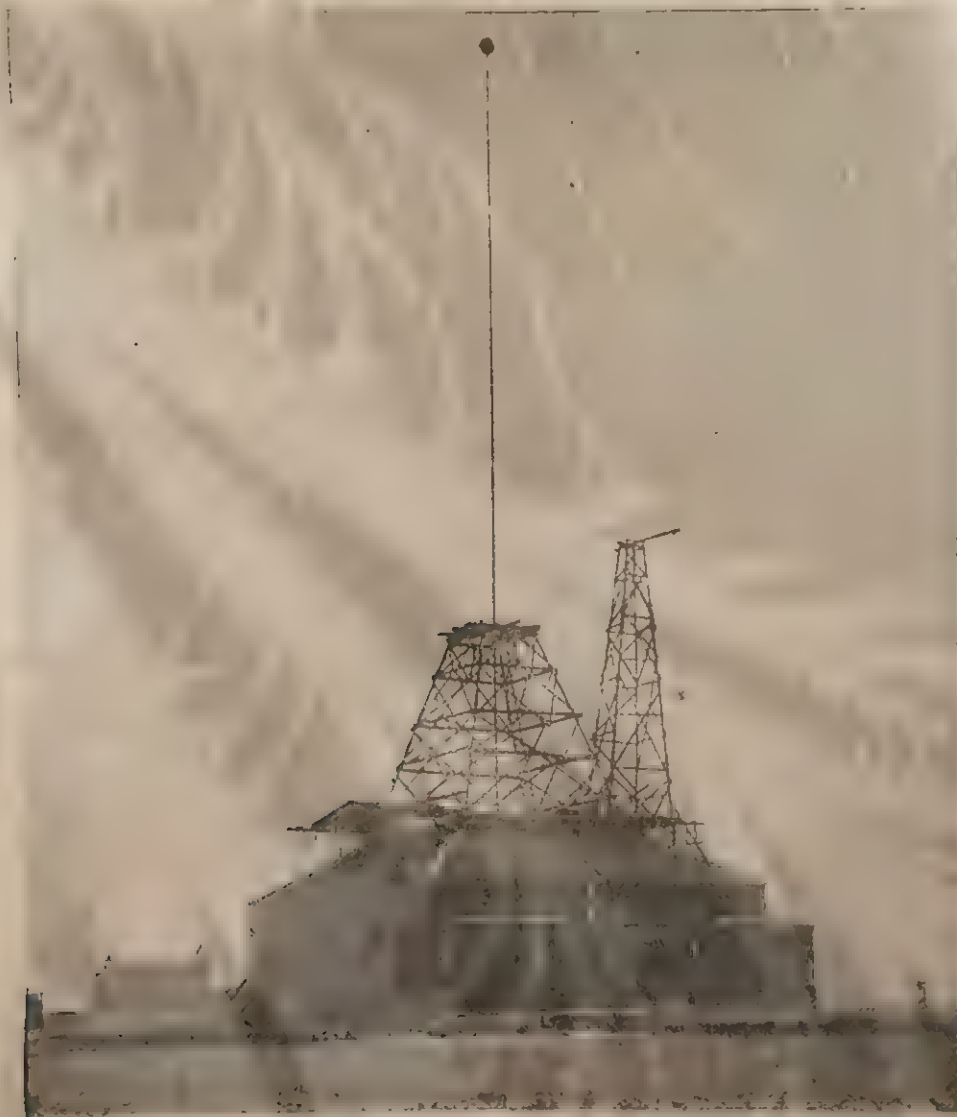


FIG. 2. A PERSPECTIVE VIEW OF THE CAMERA BODY WITH LENS CAP ON.

The camera body is made of brass and is of a rectangular shape. It has a lens at the front and a viewfinder at the top. The lens cap is made of brass and is of a circular shape. It fits over the lens and is held in place by a spring. The camera body is mounted on a base which is made of brass and is of a rectangular shape. The base has a handle on the side and a foot on the bottom. The camera body is connected to the base by a hinge. The camera body can be tilted up and down. The camera body is also connected to a shutter release which is made of brass and is of a rectangular shape. The shutter release is connected to the camera body by a wire. The shutter release has a button on the top which is used to operate the shutter. The camera body is also connected to a film advance lever which is made of brass and is of a rectangular shape. The film advance lever is connected to the camera body by a wire. The film advance lever has a handle on the side which is used to advance the film. The camera body is also connected to a film magazine which is made of brass and is of a rectangular shape. The film magazine is connected to the camera body by a wire. The film magazine has a handle on the side which is used to insert the film. The camera body is also connected to a film counter which is made of brass and is of a rectangular shape. The film counter is connected to the camera body by a wire. The film counter has a handle on the side which is used to reset the film counter. The camera body is also connected to a film advance lever which is made of brass and is of a rectangular shape. The film advance lever is connected to the camera body by a wire. The film advance lever has a handle on the side which is used to advance the film. The camera body is also connected to a film magazine which is made of brass and is of a rectangular shape. The film magazine is connected to the camera body by a wire. The film magazine has a handle on the side which is used to insert the film. The camera body is also connected to a film counter which is made of brass and is of a rectangular shape. The film counter is connected to the camera body by a wire. The film counter has a handle on the side which is used to reset the film counter.

inclusion, he might safely claim that  
d such definite objects as: (1) More  
employed; (2) coal economically work-

controlling a recording instrument, was  
the secondary circuit, while the primary  
to the ground and an elevated terminal



**FIG. 1.—TESLA EXPERIMENTAL LABORATORY IN COLO-  
RADO, ERECTED DURING THE SUMMER OF 1899.**

(The discovery by Mr. Tesla of the stationary waves in the earth was made here.)

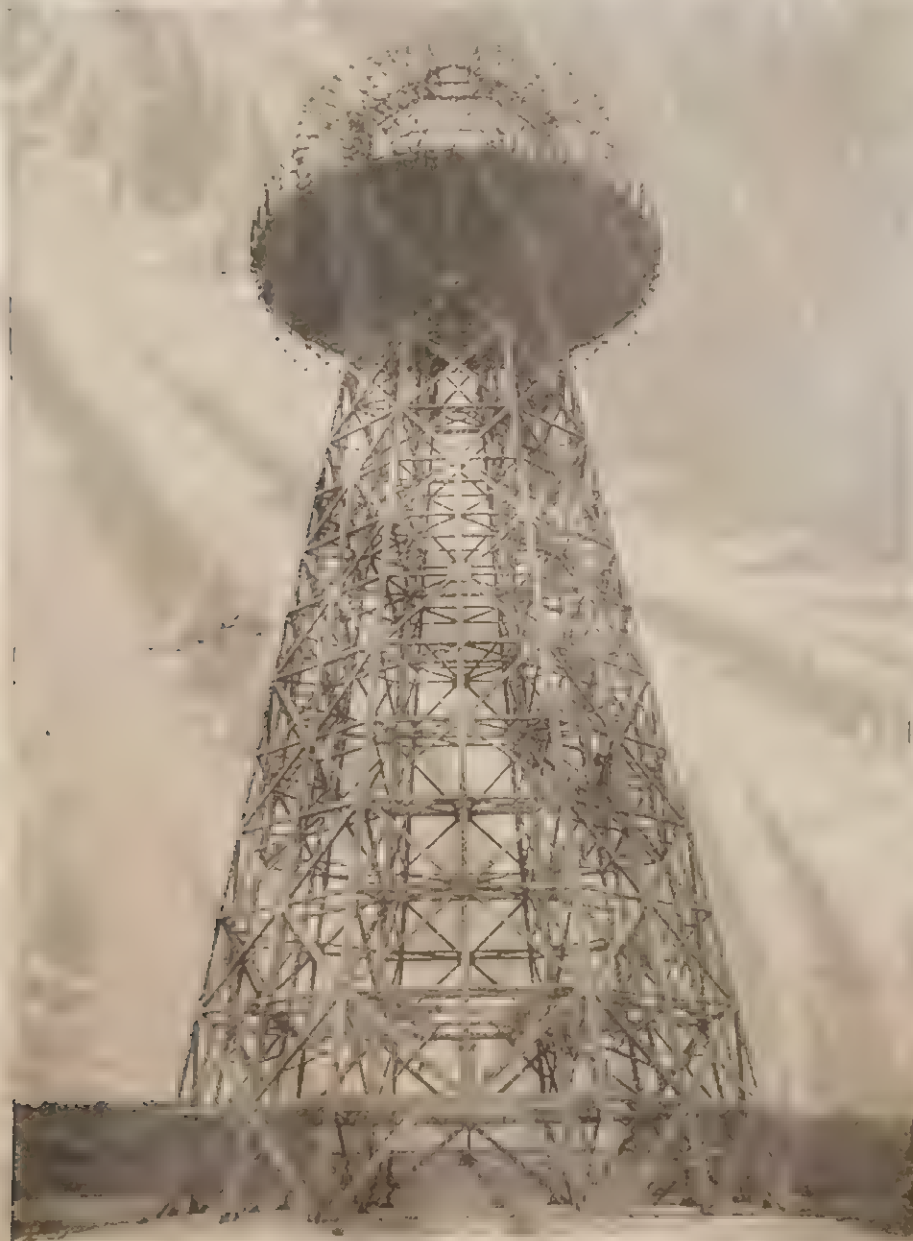
ously had been unworkable to a profit  
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three out of four mines; (5) greater  
same time in two out of four seams;  
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capacity. The variations of potential  
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secondary currents, which in turn affect  
tive device and recorder in proportion to  
ity. The earth was found to be, literally  
electrical vibrations, and soon I was de-



re. Colorado is a country famous for  
lays of electric force. In that dry  
osphere the sun's rays beat the objects

treated to a distance of about three hun-  
dred feet (186 ft. 30 in.). Nor did these strange ac-  
tions stop then, but continued to manifest themselves



**FIG. 2.—TESLA CENTRAL POWER PLANT AND TRANSMITTING TOWER FOR WORLD TELEGRAPHY, AT WARDENCLYFFE, LONG ISLAND, N. Y.**

(The tower is a pyramid having eight sides; smallest dimensions across base, 95 feet; height, 154 feet; total height from ground to top, 187 feet; cupola on top, 65.82 feet in diameter.)



FIG. 1. THE LATEST MODEL OF A DYNAMO IN COLORADO. THE MACHINE IS 10 FEET IN DIAMETER AND 15 FEET HIGH.

The dynamo is a machine which converts mechanical energy into electrical energy. It is a device which is used in a variety of ways, such as for generating electricity for power plants, for charging batteries, and for driving electric motors. The dynamo is a very important part of many industrial and domestic systems. It is a machine which is used to convert mechanical energy into electrical energy. It is a device which is used in a variety of ways, such as for generating electricity for power plants, for charging batteries, and for driving electric motors. The dynamo is a very important part of many industrial and domestic systems.

THE DYNAMO IS A MACHINE WHICH CONVERTS MECHANICAL ENERGY INTO ELECTRICAL ENERGY.

TOWARD THE CLOSE OF THE LAST CENTURY, THE SCIENTIFIC RESEARCH CAR WAS A NUMBER OF YEARS WITH THE OBJECT OF PRODUCING A DYNAMO WHICH WOULD BE ABLE TO GENERATE A LARGE AMOUNT OF ELECTRICAL ENERGY.

The dynamo is a machine which converts mechanical energy into electrical energy. It is a device which is used in a variety of ways, such as for generating electricity for power plants, for charging batteries, and for driving electric motors. The dynamo is a very important part of many industrial and domestic systems. It is a machine which is used to convert mechanical energy into electrical energy. It is a device which is used in a variety of ways, such as for generating electricity for power plants, for charging batteries, and for driving electric motors. The dynamo is a very important part of many industrial and domestic systems.



better airplanes before the war, and the output of the plant was disturbed.

preserve and maintain the output of a high-class suit as the most important thing in the world. The most important thing in the world is the most important thing in the world.

matter of great importance. The individual and the community are the most important things in the world.

and, third, to America, the most important thing in the world is the most important thing in the world.

from the through the can be the most important thing in the world.

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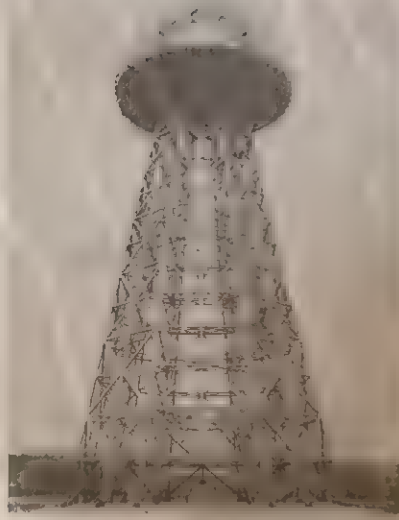


FIG. 1. TESLA CENTRAL POWER PLANT AND TRANSMITTING TOWER FOR WORLD TELEGRAPHY AT WARDENCLYFFE, LONG ISLAND, N. Y.

The tower is 157 feet high, and the power plant is 100 feet high. The tower is made of steel, and the power plant is made of iron.

and the tower is a dangerous structure. The tower is made of steel, and the power plant is made of iron. The tower is 157 feet high, and the power plant is 100 feet high.

Subsequently similar construction was made. The tower is made of steel, and the power plant is made of iron. The tower is 157 feet high, and the power plant is 100 feet high.

\*Electrician, Wardenclyffe.





[illegible]

# SCIENTIFIC AMERICAN

1845-1904 Anniversary Number — 1915



Vol. CXL No. 23  
June 5, 1915

Munn & Co., Inc., Publishers  
New York, N. Y.

Price 25 Cents  
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OF THE FIRST YEAR

# SCIENTIFIC AMERICAN

WEEKLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JUNE 5, 1915

5 CENTS A COPY  
\$3.00 A YEAR



Gordon McKay, inventor of the McKay shoe-making machines.



Isaac Singer, inventor of the Singer sewing machine.



Lyman E. Blake, inventor of shoe-making machinery.



Charles Goodyear, inventor of the Goodyear lasting machinery.



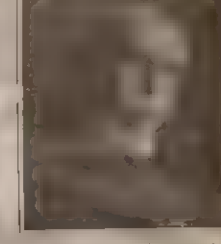
Joseph Henry, who laid the foundation of the electric telegraph.



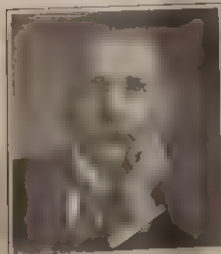
Charles J. Vandepoel, inventor of American overhead trolley system.



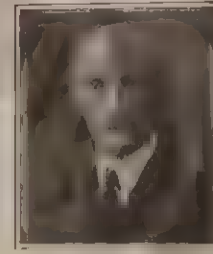
Dr. Cowman Sellers, pioneer motion picture and machine tool inventor.



Count von Zeppelin, inventor of the rigid airship.



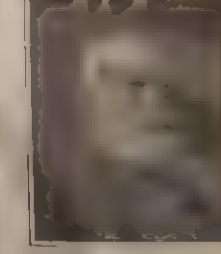
Phil J. A. Fleming, inventor of the electric valve used in wireless.



James Gayley, inventor of the dry-blast process of steel-making.



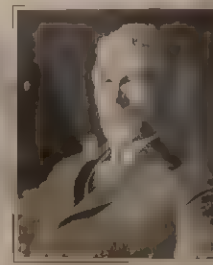
Charles E. Scribner, inventor of telephone switchboards.



J. S. Hyatt, an industrial chemist, who discovered celluloid.



William S.rague, inventor of the multiple system of train control.



Charles G. Curtis, inventor of the Curtis steam turbine.



Dr. Rudolf Diesel, inventor of the Diesel engine.



Charles P. Smyth, inventor of the electric light.

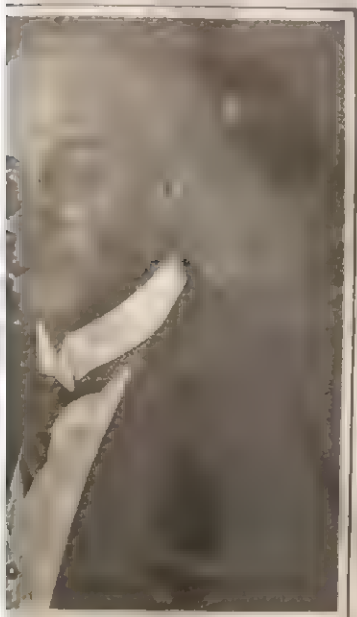
SOME GREAT INVENTORS OF THE PAST SEVEN DECADES



Alexander Graham Bell, inventor of telephone switchboards.



J. S. Hyatt, an industrial chemist, who discovered celluloid.



Rudolf Diesel, inventor of the Diesel engine.

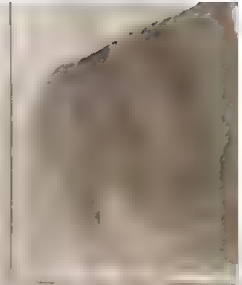


Charles P. Steinmetz, inventor of the magnetite arc.

SEVEN DECADES



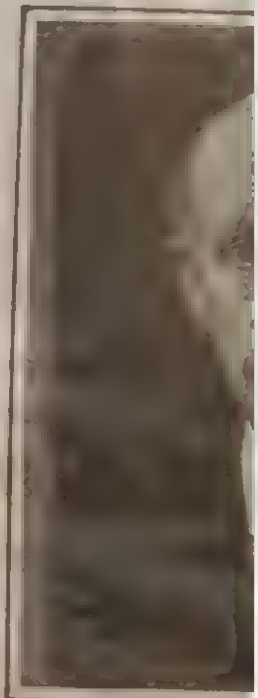
Joseph Henry, who laid the foundation of the electric telegraph.



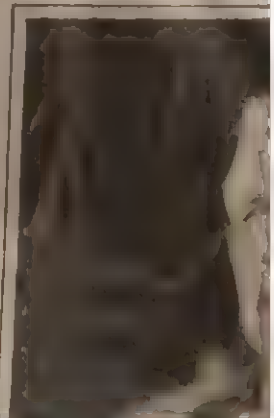
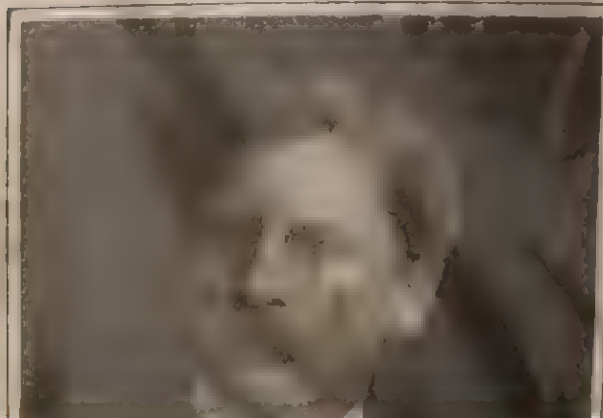
Charles J. Van Dusen, American over



Prof. J. A. Fleming, inventor of the electric valve used in wireless.



James Gayley, inventor of the blast process





product. Two Englishmen, Anthony  
he idea of splitting a web of paper  
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er by means of deflecting bars, so  
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This invention is now included in  
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Experiments of Sememikow, M. J.  
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product coke oven, an improve-  
and Hoffmann, was introduced in  
has served as the inspiration of  
ed and perfected the so-called Gart-  
out mine at home, and far from  
The new process to utilize waste  
for the production of power seems  
Joseph von Ehrenwerth in 1883.

In the same year Pelton, an American, invented the  
Pelton wheel, in which cups are used instead of blades,  
the cups being so designed that they utilize the force  
of the impinging water to the utmost.

#### Mergenthaler and His Linotype.

For many decades inventors had endeavored to sup-  
ply a satisfactory machine which would rapidly set type  
and which would enable newspaper proprietors to turn  
out papers more rapidly than was possible with hand  
composition. It was not until 1888 that such a ma-

was given through the machine  
frame properly and set the mold  
needed, while the pump and co-oper-  
cast the character and place it in it  
a tray, or "galley," at the rate of  
minute.

#### The Invention of the Au-

The first really successful modern  
bon automobile appeared in 1883,  
built by Gottlieb Daimler. His su-  
been due very largely to his autom-

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Some of Edison's work in the decade 1875-1885.

chine was invented. It was the invention of Ottmar  
Mergenthaler, and it worked on an entirely new prin-  
ciple. Instead of seeking to set the types and after their  
use to distribute them among their respective receptacles  
in order that they might be automatically composed, the  
principle on which previous inventors had worked,  
Mergenthaler composed the type-matrices, and from  
these cast, as a single piece, a line of characters. Hence,  
his machine was called a "linotype." Mergenthaler's  
matrix was of brass, flat and rectangular, having a  
V-shaped notch cut deep into its upper end, the edges of  
the notch being lined with small hook-like projections

being given off at gradually re-  
Garrett became associated with  
new ideas, among them down-  
ships either side of the vessel.  
By varying the speed of the  
of submergence could be contro-  
submarines of Turkey Greece,  
internal torpedo firing tubes  
time.

In 1880 Alexander F. Br  
chained one roller to the  
but not the other.

rebuilding an invention



# Great

Telephone and

to Marconi

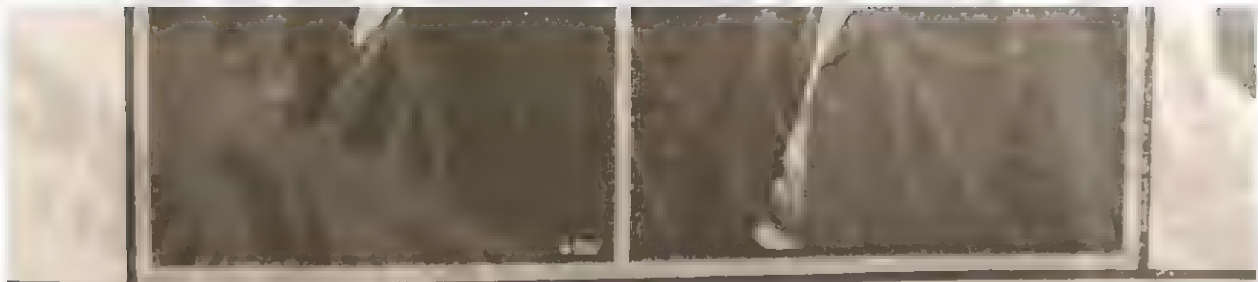


Sir William Thomson (later Lord Kelvin) inventor of the siphon recorder.

at each end, or eight in all. Aside from other material advantages it is estimated that at least from \$15,000,000 to \$20,000,000 has been saved by the Edison quadruplex, merely in the cost of line construction in America.

Another system of multiple transmission was proposed by Moses G. Farmer of Salem, Mass., in 1852, in which by a commutating arrangement the main line was put in rapid succession in contact with a series of branch wires by proper





Copyright Harris & Ewing

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Copyrighted by Brown Bros.

Prof. Michael I. Pupin, inventor of the load coil  
that made transcontinental telephoning possible.



keyboard

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...is thus, like Jews,  
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...At this June  
...In 1911

In collaboration with one wife and efforts he took. The widespread devotion since then to M. Phelps, and son, G. W. Barry as an apostle of the overlaid and outset of this

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vi Washington.

The higher instrument prints on a tape, and the speed is limited by the manual dexterity of the operator and the

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Marconi and one of his early wireless sets.

# SCIENTIFIC AMERICAN

Original of experimental from box receiver



Alexander Graham Bell.



Emile Berliner.



The first instrument



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THE ELECTRICAL  
Phenomena of Alternating Currents of Very High  
Frequency.

Phenomena of Alternating Currents of Very High Frequency.

### 1.3. NIK DLA TESTU A

ALTERNATE CURRENT MAXIMIZES HIGH FREQUENCY, CIRCULAR ELEMENTS WITH PERIODICITY AND LAMP, AN ELECTRICITY SOURCE ALTERNATING HIGH CONSTANT CURRENT AND CONSTANT POTENTIAL INTERMITTENT EXPERIMENT WITH A CONDENSER TWO PERMANENT MAINFOLDING DETERMINED IN THE FIFTEEN SECONDS, SUGGESTION OF MICROBURNING

Electrical journals are getting to be more and more interesting. New facts are observed and new problems spring up daily which demand the attention of engineers. In the last few numbers of the English journals I find queries in the *Electrician*, there have been several new matters brought up which have attracted more than usual attention. The address of Professor Crookes has revived the interest in his beautiful and skillfully performed experiments the effect observed on the Ferrat is mainly ascribed to the expressions of opinion of some of the leading English electricians and Mr Swinburne has brought out some interesting points in connection with condensers and dynamo excitation.

The writer's own experiences have induced him to venture a few remarks in regard to these and other matters, hoping that they will afford some useful information or suggestion to the reader.

Among the many experiments Professor Crookes showed us performed well, this level of internal cleanliness and freedom from particles must be inferred that the results obtained with these tubes are rather unusual. If this be so, then it would most regret that Professor Crookes' work on cathode rays has been the delight of every investigator. I am not to have availed myself of the experiments of a very poorly selected alternate current machine, namely the *radio electrica* type, known to 20,000 alternating persons. The machines in this effect that fascinating subject would that have been even more on this. It is then that when using one of the machine in connection with an induction coil, the distinctive character of the cathodes which is asserted if not both in the experiments as last, in most cases both in the cathodes having a very high, in most cases, the cathode is gained that the cathode, in the effect of it. When using a rotating switch or commutator the rate of change obtainable is a

the writer, the discharge of energy  
produce seriously in various  
coil were operated with a current  
though the electromotive force  
the discharge would be most  
suit, however, is due in part to the  
writer's experiences tend to show  
frequency the greater the amount  
may be passed through the bone  
comfort; when it seems certain that  
could sort

One is not quite prepared for the effect which is observed when connected to a Leyden jar. The capacity of the jar equates that size the frequency is high. The jar should be small. He therefore takes a jar about the size of a small wine glass. The effect with this jar the coil is practically horizontal, then reduces the capacity until he can get the capacity of two spheres, say, ten centimetres apart and two to four centimetres apart. The discharge assumes the form of a serrated band, like a succession of sparks viewed in a revolving mirror; the serrations, of course, correspond to the condenser discharges. In this case it serves a queer phenomenon. The discharge starts nearest points, breaks gradually up, breaks at the top of the spheres, begins again at the bottom. This goes on so fast that several serrated bands are in evidence. One may be puzzled for a few minutes. The explanation is simple enough. The discharge begins at the first points, the air is heated and carries the spark toward until it breaks, when it is re-established at the next points etc. Since the current passes easily through a condenser of even small capacity, it will be fed in its return, that connecting only one terminal to a condenser of any size, no matter how weakly insulated, stops the striking discharge if the arc is not broken.

Experiments with Geissler tubes are of great interest. An exhausted tube, devoid of electricity of any kind, is brought up to some distance from the coil. If the electric vacuum pump near the coil the whole of the tube is brilliantly lighted. At an intermediate lamp appears, the coil lights up and gets perceptibly hot. If the terminals connected to one of the binding screws of the coil and the other end of the tube, with a very careful

Fy. 6

[illegible]

It would take Rubinkoff a while. The primary current the cat may generate, or otherwise occur in a superconducting. The line will terminate in a long current through the old animals to the insulated cat. The animals to come any to meet acts the cat and might meet the vacuum jump tone bed with a current should

## 8 of Transformers

der from a study made of the State's  
may be interesting to the  
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*[The page contains extremely faint, illegible text, likely bleed-through from the reverse side.]*



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the fact that we have a very large number of people who are not using the machine. This is a very serious problem, and it is one that we must solve. The first step is to find out why people are not using the machine. There are many reasons for this, and we must find out what they are. One reason is that the machine is too complicated. Another reason is that the machine is too expensive. We must find out what the reasons are, and then we must find a way to solve them. This is a very important task, and it is one that we must take very seriously. We must find a way to make the machine easier to use, and we must find a way to make it more affordable. This is a very important task, and it is one that we must take very seriously. We must find a way to make the machine easier to use, and we must find a way to make it more affordable. This is a very important task, and it is one that we must take very seriously.

[illegible][illegible]

vacuum pump is hooked up, touched with its wire contacts, current should be left on so the glass will be cracked by vacuum.

The next step is to connect the vacuum pump to the vacuum chamber. The vacuum chamber is connected to the vacuum pump by means of a hose. The vacuum chamber is connected to the vacuum pump by means of a hose. The vacuum chamber is connected to the vacuum pump by means of a hose.

If however, the magnet arm and the transformer higher element be sent around a frequency of one cycle per second, the sound will be audible with still a faint audibility.

The same will be true if the  
 thickness of the second, or  
 any other, surface is in-  
 creased, and the surface  
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 amount of the metal

THE NEW YORK TIMES, SATURDAY, JANUARY 10, 1903.

120







[illegible][illegible]

... of the ...

and for the largest and best of the





pere, whether the current be unvarying or alternating.

12. That the standard of electrical pressure should be denominated the volt, being the pressure which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampère.

13. That the electrical pressure at a temperature of 62 degrees F. between the poles or electrodes of the voltaic cell, known as Clark's cell, constructed and used in accor-

at the beginning some gradually decreasing to station. Here the stream crested to two-six feet Pelton water wheels in the generating station itself. The ultimate capacity of 800 h.p. in



FIG. 3.—TESLA MOTOR USED IN THE TELLURIDE PLANT.

dance with the specification attached to these proceedings, may be taken as not differing by more than ..... parts in one thousand from a pressure of ..... volts.

the generators is provided single 100 h. p. motor station is to the generators. It was plant synchronous altern the potentials required

uring Company to supply the  
dam has been erected at what is  
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h an iron pipe 4,000 feet long.  
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is divided, and the water is deliv-

## Phenomena of Alternating Currents of Very High Frequency.

BY NIKOLA TESLA.

In the issue of THE ELECTRICAL WORLD of March 14 I find a note of Prof. Elihu Thomson relating to some of my

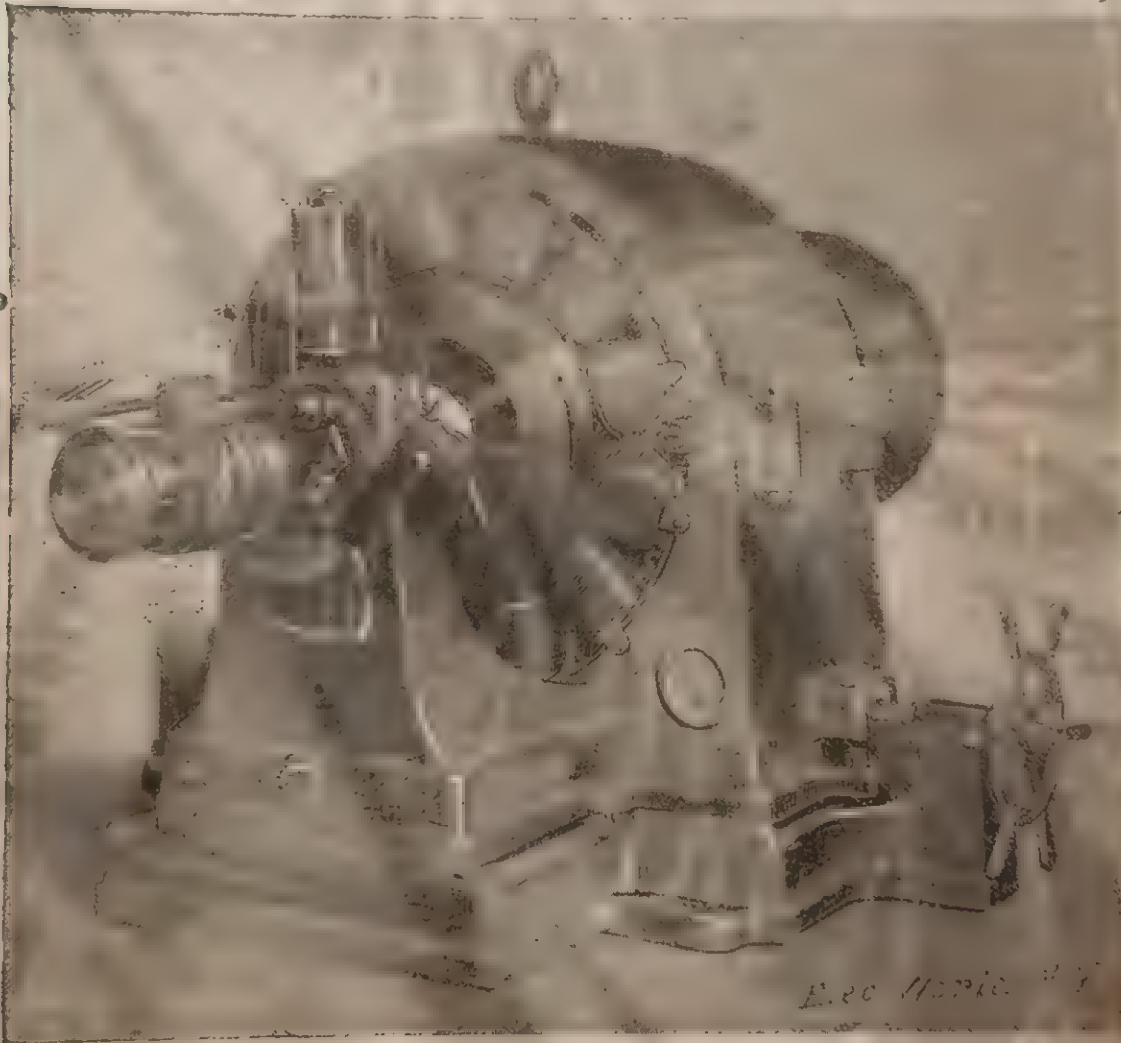


FIG. 1.—MOTOR AND GENERATOR OF THE TELLURIDE MINING PLANT.

for, although at present only a  
bine will be installed. The  
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quency which have been described in THE ELECTRICAL

2,000 h. p. Here  
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too easily obtained, and water power can be had almost for  
the asking. The plant is now rapidly nearing completion,  
and ere long we may hope to chronicle the starting of an  
installation that is unique in the electrical transmission  
of power among motor plants, and that has every reason  
to meet with most gratifying success.

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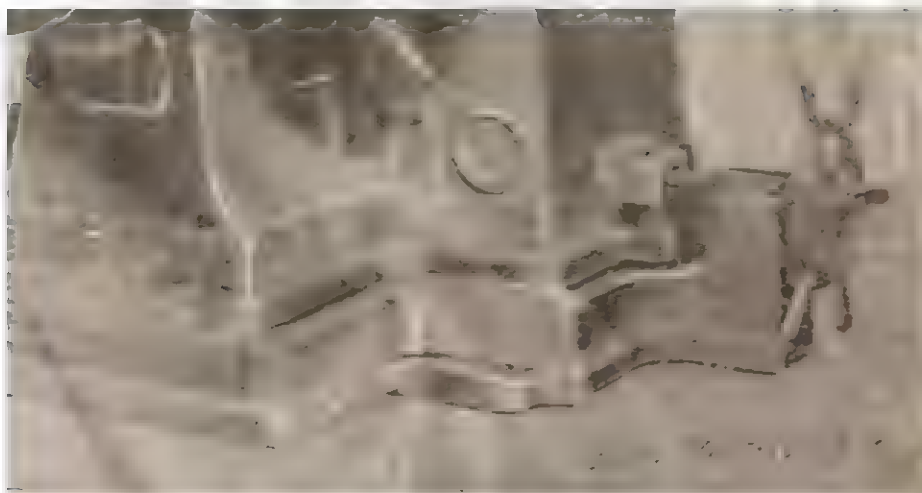
### Phenomena of Alternating Currents of Very High Frequency.

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find a note of Prof. Elihu Thomson relating to some of my







MOTOR AND GENERATOR OF THE TELLURIDE MINING PLANT.

present only a stalled. The miles from y in this large re reason that in are usually tors, and the possible, con- of potentials esirable. The the Westing- with toothed cept in some own in Fig. 1. ordinary West- wise no strik- e an electro- s are accord- cting circuit e, erected on the ground possibility of

experiments with alternating currents of very high fre- have been described in THE ELECTRICAL Vol. 21, 1891.

Prof. Thomson calls attention to the interesting fact that he has performed some experiments in the same line. I was not quite unprepared to hear this, as a letter from him appeared in *The Electrician* (London) a few months ago in which he mentioned a small alternate current machine which was capable of giving, I believe, 5,000 alternations per second, from which letter it likewise appears that his investigations on that subject are of a more recent date.

Prof. Thomson describes an experiment with a bulb inclosing a carbon filament which was brought to incandescence by the bombardment of the molecules of the residual gas when the bulb was immersed in water rendered slightly conducting by salt dissolved therein (?) and a potential of 1,000 volts, alternating 5,000 times a second, applied to the carbon strip. Similar experiments have, of course, been performed by many experimenters, the only distinctive feature in Prof. Thomson's experiment being the comparatively high rate of alternation. These experiments can also



[illegible][illegible]





[illegible]

Phenomena of Alternating Currents of Very High Frequency

BY NICHOLAS J. S. J.

Prof. Thompson states desirably in regard to the experiment with the incandescent lamp bulb and the mounted on a single arm that "cannot be at all that conduct thought to glass has to do with the phenomenon involved. It is well known fact that a number of lamp parts are made of glass, and that they are not made of glass, but says that if it is in through it with a possible solid is a very small amount. I therefore confidently assert that very few incandescent lamps are made of glass. For the purpose of the experiment, taking place it is only necessary that the lamp be of a

[illegible][illegible]





a third load instead of

A condenser takes a pressure, so that it is not in series with the current. The 100 amperes of 33 amperes in step, lagging a quarter of a microfarads will supply the dynamo supplies the amperes. This reasoning is an assumption. The troubles arising from the closed or open circuit are not mentioned.

Use the output of dynamo if a dynamo is worked causes the current to lag, the field. If a condenser in the machine, its current increases the terminal voltage. If the condenser is pure actions are great like a machine excite it. This action of a condenser is easily explained on the basis of the two theories.

According to the self-inductance is large enough to produce  $(2\pi n)^2 L K = 1$ —this is as great as if the no-load short-circuited on the armature reaction field till the field magnet, the machine is like a dynamo which has a low resistance go into this matter. A discussion of a rise in voltage will be treated, I am sure, and will certainly receive the attention of authors.

high-pressure condensers are proposed. Knowing the properties of leads and mains—in fact, and, in fact, advise to plate many hundreds of miles of the thinnest possible wire. In addition to this, the wire must be free from impurities. Work on condensers has been done, who has carried out every conceivable kind

direct-current arcs also.

Alternating constant currents have, however, one advantage over direct that I think is not realized. Synchronizing motors will run perfectly on series constant-current circuits; and as they run at constant speed, there is no lagging, or trouble about governing, as in the case of direct currents. Of course, constant speed of engine is here necessary to give constant frequency. Many people seem to have gathered from Dr. Hopkinson's paper that series alternating motors will not run; but this is a false inference.

### Phenomena of Alternating Currents of Very High Frequency.

BY NIKOLA TESLA.

I cannot pass without comment the note of Prof. Thomson in THE ELECTRICAL WORLD of April 4, although I dislike very much to engage in a prolonged controversy. I would gladly let Prof. Thomson have the last word, were it not that some of his statements render a reply from me necessary.

I did not mean to imply that whatever work Prof. Thomson has done in alternating currents of very high frequency was subsequent to his letter published in *The Electrician*. I thought it possible, and even probable, that he had made his experiments some time before, and my statement in regard to this was meant in this general way. It is more than probable that quite a number of experimenters have built such machines and observed effects similar to those described by Prof. Thomson. It is doubtful, however, whether, in the absence of any publication on this subject, the luminous phenomena described by me have been observed by others, the more so as very few would be likely to go to the trouble I did, and I would myself not have done so had I not had an advance of firm conviction gained from the study of the works of the most advanced thinkers that I would obtain the results sought for. Now that I have indicated the direction, many will probably follow, and for this very purpose I have shown some of the results I have reached.

Prof. Thomson states decisively in regard to the experiment with the incandescent lamp bulb and the filament mounted on a single wire that he cannot agree with me at all that conduction through the glass has anything to do with the phenomenon observed. He mentions the well-known fact that an incandescent lamp acts as a Leyden jar and says that "if conduction through the glass were a possibility this action could not occur." I think I may confidently assert that very few electricians will share this view. For the possibility of the condenser effect taking place it is only necessary that the rate at which the

out directly that now I see no way to do me if I call his regard, namely, the current in an arc—which does not mean 5,000 waves of sound.

He says that I have audition 10,000 waves adopted nor suggest I have been working while I have nowhere that this would be cited as an argument. Philadelphia he has wholly overlooks a length—namely, that something entirely general.

Prof. Thomson finds views expressed in that five or six years of construction of a dynamo armature coils were comparatively short in a dense magnetic field and to the field he had impedance coil which a considerable length circuit with the armature thought. "the position along with Thomson says effects would be obtainable from the he was disappointed due to Prof. Thomson result from such Earth is not farther from one in which sufficient to give the saturation and utilized, doing just the opposite. But it is, of course, that it was performed foremost electricians these and other matters. Prof. Thomson states out the periodical variation does not produce

## AL WORLD.

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machines of 1 year ago. constant current. And the output. The constant current is to use the governor off the engine against racing only. If only quarter load on, it is fully full steam, and wear-resistant-pressure dynamo it cylindrical of steam being expanded properly. To the engine, and then to over the difficulties you mention proceeding with

have. However, one admits not realized. Synchronous series constant-current constant speed, there is no lag, as in the case of direct speed of engine is hereby. Many people seem to think that series is a false inference.

## Currents of Very High Frequency.

ESLA.

the note of Prof. Thomson of April 4, although I discolored controversy. I have the last word, were to render a reply from me

it whatever work Prof. Thomson's currents of very high frequency letter published in The Electrician, and even probable. Some time before, and I meant in this general at quite a number of experiments and observed effects. Thomson. It is doubtless of any publication phenomena described by me are more so as very few I did, and I would myself an advance of firm of the works of the most famous the results sought in the direction, many will of purpose I have shown

in regard to the experiments.

ment that with a sufficiently high steady difference of potential enough current can be passed through the condenser with mercury coatings to light up a vacuum tube joined in series with the condenser. When the potential is alternating the condenser action comes in, the induction becomes insignificant, and the more so the greater the rate of alternation or change per unit of time. Nevertheless, in my opinion, conduction must always exist, especially if the glass is hot, although it may be negligible with very high frequencies.

Prof. Thomson states further that, from his point of view, I have misunderstood his statement about the limit of audition. He says that 10,000 to 20,000 alternations correspond to 5,000 to 10,000 complete waves of sound. In my first reply to Prof. Thomson's remarks in THE ELECTRICAL WORLD of March 21, 1891, I avoided pointing out directly that Prof. Thomson was mistaken, but now I see no way out of it. Prof. Thomson will pardon me if I call his attention to the fact he seems to disregard, namely, that 10,000 to 20,000 alternations of current in an arc—which was the subject under discussion—does not mean 5,000 to 10,000, but 10,000 to 20,000 complete waves of sound.

He says that I have adopted or suggested as the limit of audition 10,000 waves per second; but I have neither adopted nor suggested it. Prof. Thomson states that I have been working with 5,000 to 10,000 complete waves, while I have nowhere made any such statement. He says that this would be working below the limit of audition, and cites as an argument that at the Central High School in Philadelphia he has heard 20,000 waves per second; but he wholly overlooks a point on which I have dwelt at some length—namely, that the limit of audition of an arc is something entirely different from the limit of audition in general.

Prof. Thomson further states, in reply to some of my views expressed in regard to the constant current machines, that five or six years ago it occurred to him to try the construction of a dynamo for constant current, in which "the armature coils were of a highly efficient type, that is, of comparatively short wire length for the voltage and moving in a dense magnetic field." Exteriorly to the coils and to the field he had placed in the circuit of each coil an impedance coil which consisted of an iron core wound with a considerable length of wire and connected directly in circuit with the armature coil. He thus obtained, he thought, "the property of considerable self induction along with efficient current generation." Prof. Thomson says he expected "that possibly the effects would be very much the same as those obtainable from the regularly constructed apparatus." But he was disappointed, he adds. With all the consideration due to Prof. Thomson I would say that to expect a good result from such a combination was rather sanguine. Earth is not further from Heaven than this arrangement in





APRIL 11, 1891.

it renders the undulations more pronounced. This is self-evident. Let us insert a self-induction coil in a circuit traversed by an undulating current and see what happens. During the period of the greatest rate of change when the current has a small value, the self-induction opposes more than during the time of the small rate of change and when the current is at or near its maximum value. The consequence is that with the same frequency the maximum value of the current becomes the greater, the greater the self-induction. As the sound in a telephone depends only on the maximum value it is clear that self-induction is the very thing required in a telephone circuit. The larger the self-induction the louder and clearer the speech, provided the same current is passed through the circuit. I have had ample opportunity to study this subject during my telephone experience of several years. As regards the fact that a self-induction coil in series with a telephone diminishes the loudness of the sound, Prof. Thomson seems to overlook that this effect is wholly due to the impedance of the coil, *i. e.*, to its virtue of diminishing the current's strength. But while the current's strength is diminished the undulation is rendered only more pronounced. Obviously, when comparisons are made they must be made with the same current.

In an arc machine such as that of Prof. Thomson's the effect is different. There one has to deal with a make and break. There are then two induced currents, one in the opposite the other in the same direction with the main current. If the function of the mechanism be the same, whether self-induction coil be present or not, the undulations could not possibly be wiped out. But Prof. Thomson seems likewise to forget that the effect is wholly due to the defect of the commutator; namely, the induced current of break—which is of the same direction with the main current and of great intensity when large self-induction is present—simply bridges the adjacent commutator segments, or if not entirely so, at least shortens the interval during which the circuit is open and thus reduces the undulation.

In regard to the improvement in the feeding of the lamps by vibration or undulations, Prof. Thomson expresses a decisive opinion. He now says that the vibrations *must* improve the feeding of a clockwork lamp. He says that I "contented myself by simply saying" that I cannot agree with him on that point.

Now, saying it is not the only thing I did. I have passed many a night watching a lamp feed, and I leave it to any skilled experimenter to investigate whether my

## THE ELECTRIC

course to realize fully the rent the release ought to be up and down movement.

In regard to the physical says that in such a comparison as animal tissue the distribution by self-induction does not consider the transmission pointed out by the assistance of the body to assume either condenser or the body.

### The Stanley

As alternating current a more general use it has gone evolution as has characterized component parts of the system and more carefully, and more designed. It has taken some the alternating dynamo to and the other necessary part of the alternating system, that is, the secondary generator the transformer — has gone through somewhat the same slow process of evolution. In the early stages of the art the transformer was inefficient and regulated badly. It was improperly designed and often poorly built. Gradually the principles involved in its construction came to be understood, the parts were better proportioned to serve the purpose, and a far better quality of iron was used for the core.

We give on the present page two cuts of the very latest type of transformer. It is manufactured by the Stanley Manufacturing Company from the design of a man who has become so widely known with the rise and development of the industry. Many of the fundamental fruits of Mr. Stanley's in-

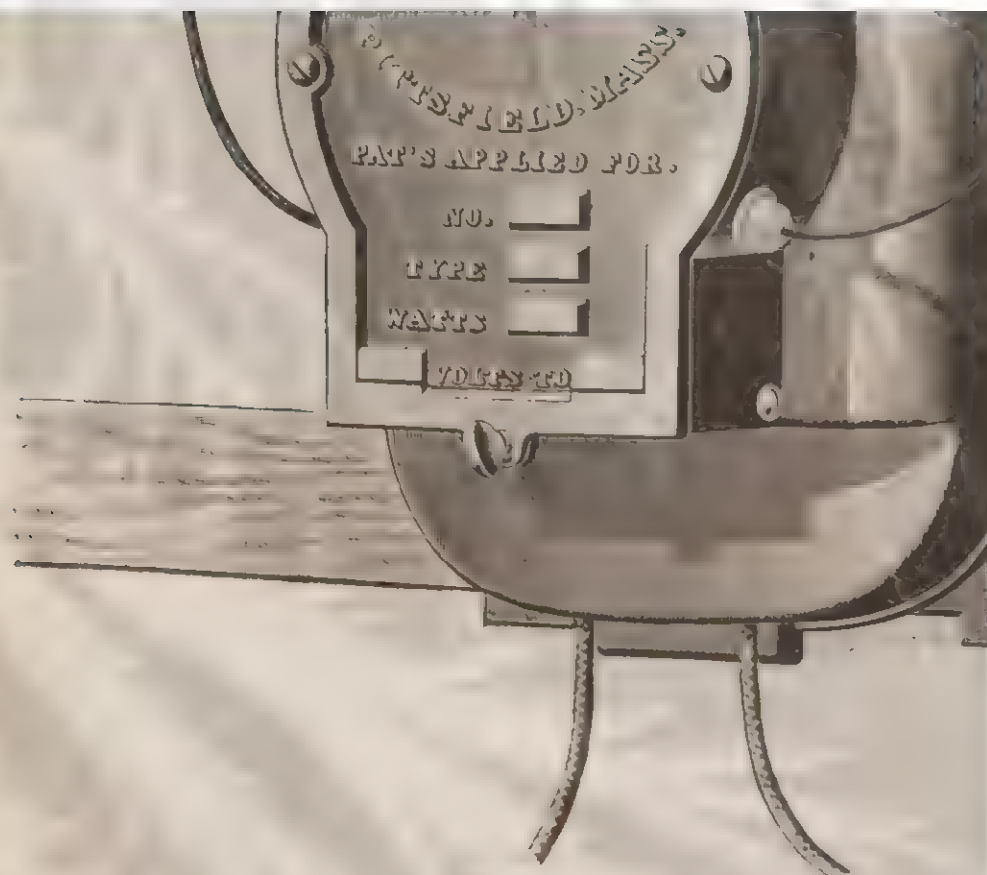


FIG. 1.—STANLEY ALTERNATING CURRENT TR

statements are correct. My opinion is that a clockwork lamp—that is, a lamp in which the descent of the carbon is regulated not by a clutch or friction mechanism, but by an escapement—cannot feed any more perfectly than tooth by tooth, which may be a movement of, say, one-sixty-fourth of an inch or less. Such a lamp will feed in nearly the same manner, whether the current be perfectly smooth or undulating, provided the conditions of the circuit are otherwise stable. If there is any advantage I think it would be in the use of a smooth current, for with an undulating current the lamp is likely to miss some time and feed by more than one tooth. But in a lamp in which the descent of the carbon is regulated by friction mechanism, an undulating current of the proper number of undulations per second will always give a better result. Of force in rent but energy. These re tested, of wind chance and a s the ins cable p safety. the fus notice. a fusibi ondary



# THE ELECTRICAL WORLD

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course to realize fully the benefits of the undulating current the release ought to be effected independently of the up and down movement, as I have pointed out before.

In regard to the physiological effects Prof. Thomson says that in such a comparatively poor conductive material as animal tissue the distribution of current cannot be governed by self-induction to any appreciable extent, but he does not consider the two-fold effect of the large cross-section pointed out by Sir William Thomson. As the resistance of the body to such currents is low, we must assume either condenser action or induction of currents in the body.

## The Stanley Transformer.

As alternating current apparatus has come into more and more general use it has gone through the same stages of evolution as has characterized direct current machines. The component parts of the system have been worked out more and more carefully, and more efficient types of the machines designed. It has taken some years of experiment to bring the alternating dynamo to its present high state of efficiency, and the other necessary part of the alternating system, that is, the secondary generator—the transformer—has gone through somewhat the same slow process of evolution. In the early stages of the art the transformer was inefficient and regulated badly. It was improperly designed and often poorly built. Gradually the principles involved in its con-

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Testimony for the Institute of Immigrant  
History

Novel Literature, May 12, 1900

Could not present to receive honorary citation.

Ms 481

From: Dr. Nikola Tesla

Mr. Charles  
Ladies and Gent

Welfare,

I can not find words to express adequately my keen regret for being unable to appear in person, the distinction which my recovery from illness months ago is already making me equal to the task of appearing in public and meeting the obligations which this would impose upon me.

My coming to this country was a great adventure -- every detail of which is still vivid in my memory. Early in 1884, while employed by a French Company in Paris, France, I made important improvements in dynamos and motors and was engaged by the Edison Company in New York to design and construct similar machines for them. It had been the height of my ambition and my most ardent wish to come in contact with Edison and see America. Accordingly, I undertook the voyage and after losing my money and tickets and passing through a series of mishaps, including a mutiny in which I nearly lost my life, I landed on these blessed shores with four cents in my pocket. My first intention was to look up a close American friend before going to the Edison establishment. On my way uptown I came to a small machine shop in which the foreman was trying to repair an electric machine of European make. He had just given up the task as hopeless and I undertook to put it in order without a thought of any compensation. It was not easy but I finally had it in perfect running condition. I was astonished when he gave me twenty dollars and wished that I had come to America years before. The next day I was thrilled to the marrow by meeting Edison who began my American education right then and there. I wanted to have my shoes shined, something I considered below my dignity. Edison said: "Tesla, you will shine the shoes yourself and like it. He impressed me tremendously. I shined my shoes and liked it.

I began the work for which I was engaged immediately and after nine months of strenuous effort I fulfilled my contract rigorously. The manager had promised me fifty thousand dollars but when I demanded payment, he merely laughed. "You are still a Russian," remarked Edison, "when you become a full-fledged American you will appreciate an American joke." I felt deeply hurt as I had expected to use the money in the development of my alternating system and when some people proposed to form a company under my name, I accepted eagerly. Here as the opportunity I had vainly sought for years but my new friends were adamant in their resolve not to have anything to do with the worthless alternating currents which Edison condemned as deadly. They desired an arc light system and I had to comply with their request though the delay of my cherished plans was agonizing. In one year of day and night application, I managed to perfect the system which was adopted for lighting the city and some factories in the neighborhood. Then came the hardest blow I ever received. Through some local influences, I was forced out of the company losing not only all my interest but also my reputation as engineer and inventor. After that I lived through a year of terrible heartaches and bitter tears, my suffering being intensified by



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... power. He was a pioneer  
... noblemen of whom  
... to whom humanity owes an immense

I have to add that in all my troubles I did not neglect to declare my intention of becoming a citizen of this glorious country and in due course I secured my papers making me a proud and happy man.

Nikola Tesla

S-28

April or May, 1938

M55 481

From: Dr. Nikola Tesla

Mr. Chairman,  
Members of the Institute of Immigrant Welfare,  
Ladies and Gentlemen:

I can not find words to express adequately my keen regret for being unable to receive, in person, the high distinction which the Institute of Immigrant Welfare has conferred upon me. Although my recovery from injuries sustained in an automobile accident six months ago is almost complete, I do not feel equal to the task of appearing in public and meeting the obligations which this would impose upon me.

My coming to this country was a great adventure -- every detail of which is still vivid in my memory. Early in 1884, while employed by a French Company in Paris, France, I made important improvements in dynamos and motors and was engaged by the Edison interests in New York to design and construct similar machines for them. It had been the height of my ambition and my most ardent wish to come in contact with Edison and see America. Accordingly, I undertook the voyage and after losing my money and tickets and passing through a series of mishaps, including a mutiny in which I nearly lost my life, I landed on these blessed shores with four cents in my pocket. My first intention was to look up a close American friend before going to the Edison establishment. On my way uptown I came to a small machine shop in which the foreman was trying to repair an electric machine of European make. He had just given up the task as hopeless and I undertook to put it in order without a thought of any compensation. It was not easy but I finally had it in perfect running condition. I was astonished when he gave me twenty dollars and wished that I had come to America years before. The next day I was thrilled to the marrow by meeting Edison who began my American education right then and there. I wanted to have my shoes shined, something I considered below my dignity. Edison said: "Tesla, you will shine the shoes yourself and like it. He impressed me tremendously. I shined my shoes and liked it.

I began the work for which I was engaged immediately and after nine months of strenuous effort I fulfilled my contract rigorously. The manager had promised me fifty thousand dollars but when I demanded payment, he merely laughed. "You are still a Parisian," remarked Edison, "when you become a full-fledged American you will appreciate an American joke." I felt deeply hurt as I had expected to use the money in the development of my alternating system and when some people proposed to form a company under my name, I accepted eagerly. Here as the opportunity I had vainly sought for years but my new friends were adamant in their resolve not to have anything to do with the worthless alternating currents which Edison condemned as deadly. They desired an arclight system and I had to comply with their request though the delay of my cherished plans was agonizing. In one year of day and night application, I managed to perfect the system which was adopted for lighting the city and some factories in the neighborhood. Then came the hardest blow I ever received. Through some local influences, I was forced out of the company losing not only all my interest but also my reputation as engineer and inventor. After that I lived through a year of terrible heartaches and bitter tears, my suffering being intensified by



material want. Very often I was compelled to work as a laborer and my high education in various branches of science, mechanics and literature seemed to me like a mockery. Finally, I had the good fortune of meeting two capable and honest men who listened to me and came to my assistance. They organized a company, provided a laboratory and gave me a modest but sure financial support. I perfected my motors quickly having nothing else to do except to carry out plans I had formed years before. My inventions proved a success and attracted the attention of George Westinghouse. He was, in my opinion, the only man on this globe who could take my alternating system under the circumstances then existing and win the battle against prejudice and money power. He was a pioneer of imposing stature, one of the world's true noblemen of whom America may well be proud and to whom humanity owes an immense debt of gratitude.

I have to add that in all my troubles I did not neglect to declare my intention of becoming a citizen of this glorious country and in due course I secured my papers making me a proud and happy man.

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